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# (FINAL REPORT)

# DYNAMICS OF PREDATION UPON A RAPTOR PREY BASE IN THE SNAKE RIVER BIRDS OF PREY NATURAL AREA, IDAHO

Submitted by
Maurice G. Hornocker, Principal Investigator
Steve Cherry, Research Associate
John P. Messick, Research Associate
Jackson S. Whitman, Research Aid
J. Copeland, Research Aid

Contractor
Idaho Cooperative Wilflife Research Unit
University of Idaho
Moscow, Idaho 83843

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Daniel L. Sedlock
Contracting Officer
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# SUMMARY

Over 1000 coyote (*Canis latrans*) scats were collected during this study with most of these being collected between March 1977 and November 1977. Black-tailed jackrabbits (*Lepus californicus*) were discovered to be the major prey species of coyotes. Townsend ground squirrel (*Spermophilus townsendi*) was the primary rodent species taken.

Ages were determined for 241 coyotes based on the number of cementum annuli in their canines or premolars. A total of 151 coyotes were chosen from this collection for the estimation of survival rates. Forty of these 151 were from the winter of 1975-76, 50 were collected during the winter of 1976-77, and 61 were collected in September 1977. The Chapman-Robson technique was used to estimate survival. Adult survival rates were estimated to be roughly 70 percent. Total population survival was about 60 percent.

A total of 60 female coyote reproductive tracts were collected and analyzed. The springs of 1975, 1976, and 1977 were represented in this sample. The average number of placental scars per coyote was 6.5 in the spring of 1975, 6.0 in the spring of 1976, and 6.67 in the spring of 1977. The total coyote reproductive rate for the spring of 1977 was 286 young/100 females.

Several indices of relative abundance were examined. The general population trend in coyote numbers appeared to be one of overall decrease since the early 1970's to the present.

A coyote energetics model was developed using literature values, and this information was coupled with a hypothetical coyote population to estimate seasonal energy intake. Using this energetics-population model and literature values of jackrabbit and Townsend ground squirrel densities it was *tentatively*

concluded that coyotes have the potential to affect jackrabbit population dynamics with *possible* concurrent detrimental effects on the golden eagle (*Aquila chrysaetos*) population. Coyotes on the study area probably do not affect other prey populations to any great extent.

## INTRODUCTION

The Snake River Birds of Prey Natural Area (BPNA) was established in October 1971 to protect the nesting habitat of the densest breeding population of raptors in the world. The Bureau of Land Management was charged with the responsibility of managing this unique natural resource. The BLM recognized early that the development of a sound management plan required a solid base of information on the ecology of the BPNA. Accordingly, in 1975 an ambitious team research project consisting of seven integrated studies was begun. The goals of this project were to determine the habitat requirements and population dynamics of the raptors, their prey base, and potential competitors; to predict what effect habitat alteration would have on the raptors and their principal prey species; and to develop a management plan for the BPNA (Kochert 1975).

One of the seven studies was designed to investigate the impact that the principal mammalian predators had on the raptor prey base. Of particular interest were the roles of the badger (*Taxidea taxus*), coyote, and bobcat (*Lynx rufus*) in this ecosystem. Field work commenced in the winter of 1975 and two extenuating circumstances became apparent immediately that caused changes in the overall objectives of the study: (1) there were very few bobcats on the study area, so few in fact that they could not possibly be affecting the raptor prey base; and (2) coyotes and badgers were both present in such numbers that one researcher could not hope to gather the information necessary to fulfill the objectives of the original study. The study was divided into two separate, somewhat independent undertakings in the winter of 1977. In March 1977, S. Cherry assumed responsibilities for the coyote study from J. Messick who continued the badger project. This report presents and discusses the results of the coyote segment of the study. All bobcat data collected and analyzed are presented in the Appendix (Tables A-1 and A-2), but are not discussed in this report. Specifically, the objectives of the research reported herein were to:

1. Collect information on relative abundance, reproduction, and survival rates of coyotes.
2. Collect information on seasonal food habits of coyotes.
3. Incorporate food habits and population data with energetics information from the literature to estimate predation intensity of coyotes on the raptor prey base.

## THE STUDY AREA

The BPNA is located approximately 56 km south of Boise, Idaho, and extends for about 0.4 km on either side of the Snake River for approximately 53 km. The Snake River Birds of Prey Study Area (BPSA) is a much larger area of 1933 $km^2$ which extends from Walters Ferry, Idaho, to Hammett, Idaho, and stretches out for roughly 8 km on either side of the river (Fig. 1). Located within the BPSA is a 133 $km^2$ intensive study area which includes the BPNA plus an additional 11 km stretching SE along the river.

The Snake River Canyon is the predominant geologic feature of the BPSA. The canyon and its rugged sidedraws are composed of volcanic rock (basalt and lava). Cliffs ranging from 8 m to 183 m line much of the river through the

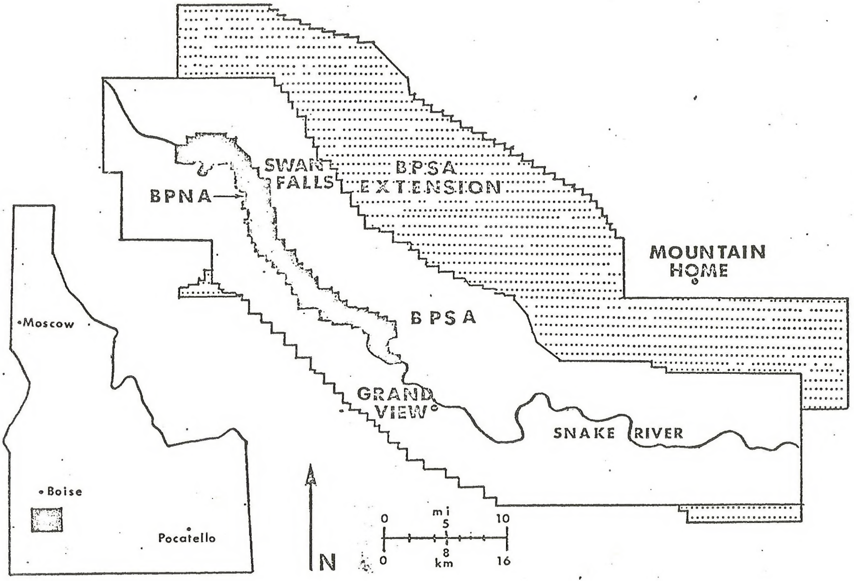

Fig. 1. Location of the Snake River Birds of Prey Study Area showing the Natural Area and the 1977 expansion area.

BPSA. The terrain surrounding the river and canyon is generally flat to rolling with occasional rocky outcroppings. Several buttes, rising as much as 150 m above the desert floor, are scattered throughout the area.

Climate of the BPSA is characterized by hot summers and mild winters. Annual precipitation averages 20 cm and falls primarily during the winter. The BPSA lies in the Upper Sonoran Desert Life Zone. Major vegetation types are big sagebrush (*Artemisia tridentata*), winterfat (*Cerratoides lanata*), greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), and cheatgrass (*Bromus tectorum*). Other common species present in association with the above include rabbitbrush (*Chrysothamnus* sp.), spiny hopsage (*Atriplex spinosa*), budsage (*Artemisia spinescens*), horsebrush (*Tetradymia* sp.), Sandberg bluegrass (*Poa sandbergii*), fescues (*Festuca* sp.), and wheatgrass (*Agropyron* sp.).

The above description of the study area is taken from Montan (1977). A more complete description of the vegetation, physiography, and wildlife can be found in Sigler et al. (1972), Meiners (1970), Wilson (1975), and Goodnight (1973).

Livestock grazing and farming are the principal land uses within the BPSA. No new agricultural developments will be allowed in the area until research ends in 1979. The Idaho National Guard conducts annual manuevers over a large portion of the study area, including a 35 km$^2$ area used as an artillery and aerial gunning range.

# METHODS

## Food Habits

Food habits information was gathered from three sources: scats, colon samples, and stomachs.

A total of 285 km of scat lines were established throughout the BPSA in May 1977; 245 km were established north of the river and 39 km were established south of the river. The lines were run twice a month during May, June, and July 1977, and once a month thereafter until November 1977, when scat collections ceased. Prior to May 1977, scat had been collected whenever they were encountered.

Stomachs and colon samples (when present) were collected from all coyote carcasses.

All scat and colon samples were analyzed by J. Whitman and J. Copeland, Idaho Cooperative Wildlife Research Unit, University of Idaho. The number of individuals in each scat was determined using teeth and bones. All stomachs were analyzed by S. Hoffman, Department of Wildlife Science, Utah State University, Logan.

## Coyote Population Parameters

Much of the population information came from analysis of teeth and reproductive tracts collected from coyote carcasses. Most carcasses were provided by various trappers, but road kills were collected whenever they were encountered. In addition, 61 animals were collected by aerial gunning in September 1977.

Reproductive tracts were collected from all female carcasses, and a tooth was pulled from every animal for aging purposes. A premolar was collected from the 61 carcasses collected in September 1977. A canine was pulled from all others.

## Aging

All teeth collected during the study were decalcified, sectioned, and aged. Teeth were decalcified in a 5 percent nitric acid solution. Teeth were checked every 4 to 6 hours to insure that decalcification had not proceeded too far. The nitric acid solution was changed every 12 hours. Canines required 12 to 72 hours for decalcification and premolars required 4 to 8 hours. All teeth were rinsed in a running cold water bath for 48 to 72 hours and stored in 70 percent ethyl alcohol until they were sectioned. Prior to sectioning all teeth were again rinsed in a running cold water bath for 24 hours. Teeth were sectioned in a cryostat; several sections from each tooth were placed on a slide and stained with Paragon stain. The number of annuli was determined immediately after staining, and an age was assigned to the animal following the suggestions of Linhart and Knowlton (1967).

Since coyotes do not lay down an annulus until their second year, neither juveniles nor yearlings will have cementum annuli in their teeth. Another method must be used to separate juveniles from yearlings. Knudsen (1976) described a technique for such separation based on canine pulp cavity size. This technique was used here. All canine teeth were cut in half at the gum line and the ratio of pulp cavity length to total tooth length was determined. If this ratio was greater than 0.32 then the animal was considered an adult (yearling or older). Separating juveniles from yearlings was more subjective when premolars were used. The technique used was suggested by J. Knudsen and W. Tzilkowski (personal communication). It involved separation of the two age classes based on a combination of factors including thickness of the cementum layer, the distance the cementum extended up the side of the tooth, size of the pulp cavity, tooth size, and speed of decalcification. In general, more cementum, smaller pulp cavity, larger tooth, and longer decalcification time indicated an older animal.

## Estimation of Survival Rates

Survival rates were estimated from coyote age structures using the Chapman-Robson method (Chapman and Robson 1960, Robson and Chapman 1961). This estimator was chosen because it is possible to test whether or not the age structure in question meets the assumptions of the method. The assumptions are (Seber 1973):

1. Constant survival rates
2. Unchanging population size
3. Random sampling

These three assumptions imply that the age structure must assume a geometric distribution. If it does, then "for all practical purposes" the assumptions have been met and the estimator is valid. If the age structure as a whole does not assume a geometric distribution then it is sometimes possible to partition out the offending segment and calculate a survival estimate for that segment of the age structure that does follow a geometric distribution. A more detailed discussion of the theory of the technique and the testing of its assumptions can be found in Chapman and Robson (1960), Robson and Chapman (1961), and Seber (1973).

## Natality

Reproductive tracts were stored in either AFA or Bouin's solution. Uteri were opened and examined for the presence or absence of placental scars. Ovaries were sectioned into five or six thin longitudinal sections and examined for presence or absence of follicular activity, corpora lutea, and corpora albicantia depending on date of collection of the sample.

Pregnancy rates were determined by computing the percentage of females with placental scars. Litter sizes were determined by counting the number of placental scars. Total reproductive rate, expressed as number of young per 100 females, was obtained by multiplying litter size by the pregnancy rate. This was done only for the spring 1977 breeding population because of small sample sizes for the springs of 1975 and 1976.

## Relative Abundance

The U.S. Fish and Wildlife Service has been conducting a western United States predator abundance survey every fall since 1972. The rationale and technique are described in Linhart and Knowlton (1975). Briefly, the technique involves the establishment of a 23.7 km line with 50 scent stations set 0.5 km apart on the line. The scent stations consist of a small plastic capsule filled with a synthetic volatile fatty acid mixture (prior to 1976 a commercially produced fermented egg attractant was used) placed in the middle of a 1 m diameter circle of sifted earth. These stations are placed alternately on the left and right side of the road. The survey lines are run for four consecutive days and the scent stations maintained as required. A "coyote visit" occurs when one or more identifiable coyote tracks occur inside the circle of earth. The index of relative abundance is calculated as follows:

$$\text{Index} = \frac{\text{Total No. Coyote Visits}}{\text{Total No. Operative Station Nights}} \times 1000$$

Two survey lines have been run on or near the study area since 1972. In the fall of 1974, two other lines were added. The results from these lines represent an index of fluctuations in coyote abundance in an area that includes the BPSA.

Every fall and winter since 1972 an aerial golden eagle survey has been conducted on the BPSA and surrounding areas by BLM personnel associated with the BPNA. All coyotes seen during these surveys are recorded. The average number of coyotes seen per transect represents another index of abundance.

A third relative abundance index was calculated from the number of coyotes seen by BLM personnel who made regular visits to the same raptor nests every 4 days between 1 April and 1 July in 1971, 1975, 1976, and 1977. All coyotes seen were recorded in field notes. The average number seen per observer-day was calculated from these notes and this represents the third index.

In addition to the three indices discussed above, the average number of scats collected per kilometer of scat line traveled was computed. Only fresh scats known to have been deposited during a particular month were included. This index provided information on relative abundance within the study area and also insight into activity patterns.

## Coyote Energetics

The basal metabolic rate (BMR) of mammals can be estimated from the equation (Kleiber 1961):

$$\mathrm{BMR} = 70 \cdot W_{\mathrm{kg}}^{0.75}$$

where $W_{kg}$ is body weight in kilograms. BMR represents the minimal heat production (kcal/day) of an animal. It is typically measured on a non-active animal in a post-absorptive condition at a temperature within the animal's thermoneutral zone (Kleiber 1961). Such terms as fasting metabolic rate, resting metabolic rate, and average daily metabolic rate are also encountered in the literature. Each of these terms refers to a measurement of metabolism in which one of the standard conditions of BMR measurement may be violated. Resting metabolic rate, for example, may include some energy for thermoregulation and the animal is usually not in a post-absorptive condition.

One common way of estimating the energy cost of free existence in the past has been to multiply one of the above measures of metabolism by a constant (see Gessaman 1973 for a review). Constants used in the past have ranged between 1.5 and 3.0 depending on species and measure of metabolism. J. A. Gessaman (personal communication) suggested a constant of 2.5 x BMR for the coyote.

Production energy costs will be considered separately. Included in production costs are reproduction and growth of pups. Reproduction does not begin to exert any appreciable additional cost until the latter third of gestation. At that point energy costs mount rapidly. Measurements made on a variety of wild and domestic species indicate increases in energy requirements of from 50 percent to 300 percent (Elsley 1971, Hadjipieris and Holmes 1966, Kaczmarski 1966, Migula 1969, Millar 1975, Randolph et al. 1977). Food consumption of captive pregnant or lactating coyotes at the U.S. Fish and Wildlife Service's Predator Ecology and Behavior Project's coyote research site at Millville, Utah, is roughly 2.5 times that of non-reproductive animals (S. Cherry, unpublished data). These animals are fed a homogeneous commercial mink food of relatively constant fat, protein, and carbohydrate content during this period of the year. It seems reasonable to assume that the energy intake of pregnant or lactating coyotes also increases by approximately 2.5 times over nonreproductive animals. The energy cost of free existence of adult pregnant females will be estimated by multiplying BMR by 6.25 (2.5 x 2.5) during the latter third of pregnancy and during lactation.

Pups require additional energy to put on tissue in body growth. The amount of energy required for growth was determined in the following manner. First, pup BMR was determined by using Kleiber's (1961) equation and pup weights at various stages of their postnatal development. (Pup weights were kindly provided by Mr. W. Stephenson, U.S. Fish and Wildlife Service, Utah State University-UMC 52, Logan, Utah 84322). These values were then multiplied by 2.5 to estimate existence metabolism in kcal/day. The average weight gain of pups in g/day was then determined and, assuming a 70 percent water content and approximately 5 kcal/g dry weight of protein, the energy gain in kcal/day was estimated. A further assumption made was that growth efficency was roughly 55 percent (J. Gessaman, personal communication), and based on this the amount of kcal/day a pup would require to gain the estimated energy calculated above was determined.

The above calculations result in estimates of energy needs for maintenance and production. Since coyotes are not 100 percent efficient in their utilization of dietary energy they must actually consume more energy than the above reasoning indicates. It was assumed that the digestive efficiency of both young and adult coyotes was 90 percent and the number of additional kcal/day they would need to consume to meet their energy requirements given this digestibility coefficient was estimated. The value of 90 percent is a reliable estimate of carnivore digestive efficiency in general, with values from a wide range of carnivores falling around it (Davison et al. 1978, Golley et al. 1965, Grodzinski and Wunder 1977, Jense 1968).

## RESULTS

### Food Habits

Food habits results are presentedin three ways: (1) frequency of occurrence of food items in all scats, (2) percentage of identified mammalian prey items found in all scats, and (3) relative percent biomass of important mammalian food items. It was originally planned to present a "relative percent energy consumed" of important mammalian food items by converting biomass to kcal. However, the value of 1.5 kcal/g live weight was found to be relatively general for the important rodent species consumed (Fleharty et al. 1973, Kaufman et al. 1975, Schreiber and Johnson 1975). No comparable values of live weight caloric density of black-tailed jackrabbit and cottontail rabbit (*Sylvilagus nuttalli*) could be found in the literature, and these species were assumed to contain 1.5 kcal/g live weight. Thus, relative percent energy and relative percent biomass are identical.

Each of the above methods has advantages and disadvantages. The frequency of occurrence of food items in scats is simply the number (or percentage) of scats in which a given food item occurs. If the number of scats collected during a period is large enough (> 25) frequency of occurrence results will be expressed as percentages. The major disadvantages of this method are that large and small items (e.g., domestic cow vs grasshoppers) are weighted the same and that many individuals of one prey species in one scat are weighted the same as one individual of that species in another scat.

Method 2 theoretically corrects for the latter bias discussed above by estimating the number of individual prey items in each scat as determined by using teeth and bones. This method determines the percentage of the total number of identified individuals each taxonomic category comprises. One must assume that either 100 percent of all items are discovered, or that all prey are identical with respect to detectability in the scat (i.e., there is no differential digestibility of prey items) for this method to be strictly accurate.

Converting the above values to biomass theoretically corrects for the problem of large and small items being weighted the same in the scats. However, this technique has the same assumptions as those discussed above for method 2. In addition, one is faced with the problem of what weight to use (Weaver 1977). Generally, average adult weights are used (e.g., see Nellis et al. 1972 and Rusch et al. 1972). Some researchers have attempted to refine this approach by estimating the age of the rodents in their samples (Weaver 1977). The only prey species in this study whose age was determined was the black-tailed jackrabbit. Approximately 33 percent of the black-tailed and unidentified lagomorphs found in spring scats in this study were classified as immature. Many of these could be classified only as unidentified immature lagomorph because of the difficulty in distinguishing immature black-tailed jackrabbits from cottontail rabbits. However, identified black-tailed jackrabbits outnumbered identified cottontails to such an extent that it was assumed for simplicity that the 33 percent juvenile value applied only to black-tailed jackrabbits. Average adult weights were applied to 67 percent of the jackrabbits in the sample and an average juvenile weight was applied to 33 percent of the jackrabbits during the spring and summer of each year.

The weights assigned to the unidentified lagomorph group were based on the proportion of cottontail rabbits and jackrabbits in the identified lagomorph group. In other words, if the cottontails made up 10 percent of the identified lagomorph then the weight assigned to the unidentified lagomorphs was a weight composed of 10 percent cottontail and 90 percent black-tailed jackrabbit. The weights used for the predominant mammalian prey species and their references are presented in Table 1.

Food habits results are presented in Tables 2-16. Some scats were collected prior to the summer of 1976, but sample sizes for these earlier periods are so few that they are of anecdotal interest only and have been included in the Appendix (Tables A3-A7). The common and scientific names of all species found in the diet of the coyote are presented in Table A8 in the Appendix.

The diet of BPSA coyotes is quite diverse. Mammals as a group clearly constitute the bulk of the diet. The most common mammals were the lagomorphs, particularly the black-tailed jackrabbit, which generally made up more than 20 percent of the diet by frequency of occurrence and more than 10 percent of the identified mammalian prey items. Other common species were kangaroo rat (*Dipodomys* sp.), mountain vole (*Microtus montanus*), Townsend ground squirrel, deer mouse (*Peromyscus maniculatus*), and domestic cattle (*Bos taurus*). There were several species that, while not occurring in a high percentage of scats, were still not uncommon. These included harvest mouse (*Reithrodontomys megalotis*), pocket gophers (*Thomomys* sp.), Great Basin pocket mouse (*Perognathus parvus*), badger, skunk (both *Mephitis mephitis* and

Table 1. Average body weights used in biomass conversions of important mammalian prey species.

| Species | Weight (grams) | Reference |
|---|---|---|
| Black-tailed jackrabbit | | |
| Adult | 2110 | C. Stoddart (PC)[a] |
| Juvenile | 1500 | C. Stoddart (PC) |
| Cottontail rabbit | 650 | Wolfe et al. (1976) |
| Townsend ground squirrel | | |
| April | 169 | G. Smith (PC) |
| May-July | 172 | G. Smith (PC) |
| Pocket gopher | 240 | Hall (1946) |
| Deer mouse | 20 | Wolfe et al. (1976) |
| Mountain vole | 30 | Wolfe et al. (1976) |
| Ord's kangaroo rat | 50 | Screiber (1973) |

[a] PC--personal communication.

Table 2. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 43 coyote scats collected on the Snake River Birds of Prey Study Area, June 1976 to August 1976. The total number of identified mammalian prey items was 79. Sample sizes are in parentheses. (Tr: Trace < 1.0%)

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 23.3 (10) | 13.9 (11) | 66.5 |
| Cottontail rabbit | 4.7 (2) | 2.5 (2) | 4.1 |
| Unknown lagomorph | 2.3 (1) | 1.3 (1) | 5.7 |
| Townsend ground squirrel | 74.4 (32) | 50.6 (40) | 21.7 |
| Mountain vole | 2.3 (1) | 1.3 (1) | Tr |
| Kangaroo rat | 16.3 (7) | 8.8 (7) | 1.1 |
| Deer mouse | 11.6 (5) | 15.0 (12) | Tr |
| Pocket gopher | 2.3 (1) | 1.3 (1) | |
| Harvest mouse | 2.3 (1) | 1.3 (1) | |
| Wood rat | 2.3 (1) | 1.3 (1) | |
| Coyote | 2.3 (1) | 1.3 (1) | |
| Unknown mammal | 2.3 (1) | 1.3 (1) | |
| AVIAN | | | |
| Raven | 2.3 (1) | | |
| Unknown bird | 2.3 (1) | | |
| REPTILE | | | |
| Unknown lizard | 2.3 (1) | | |
| INVERTEBRATE | | | |
| Beetles | 11.6 (5) | | |
| Grasshopper | 9.3 (4) | | |
| Scorpion | 7.0 (3) | | |
| PLANT | | | |
| Grass | 9.3 (4) | | |
| Shadscale | 4.7 (2) | | |
| Miscellaneous vegetation | 47.0 (20) | | |
| INORGANIC | 37.2 (16) | | |

Table 3. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 38 coyote scats collected on the Snake River Birds of Prey Study Area, September 1976 to November 1976. The total number of identified mammalian prey items was 34. Sample sizes are in parentheses. (Tr: Trace < 1.0%)

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 29.0 (11) | 32.3 (11) | 84.6 |
| Cottontail rabbit | 5.3 (2) | 5.9 (2) | 4.7 |
| Unknown lagomorph | 2.6 (1) | 2.9 (1) | 6.7 |
| Townsend ground squirrel | 15.8 (6) | 17.6 (6) | 3.8 |
| Deer mouse | 7.9 (3) | 8.8 (3) | Tr |
| Unknown microtine | 2.6 (1) | 5.9 (2) | |
| Unknown cricetid | 5.3 (2) | 5.9 (2) | |
| Striped skunk | 2.6 (1) | 2.9 (1) | |
| Badger | 2.6 (1) | 2.9 (1) | |
| Domestic cow | 13.2 (5) | 14.7 (5) | |
| AVIAN | | | |
| California quail | 2.6 (1) | | |
| Mallard | 2.6 (1) | | |
| Starling | 2.6 (1) | | |
| Unknown bird | 5.3 (2) | | |
| INVERTEBRATE | | | |
| Beetles | 13.2 (5) | | |
| Grasshopper | 10.5 (4) | | |
| Scorpion | 2.6 (1) | | |
| PLANT | | | |
| Hackberry seeds | 7.9 (3) | | |
| Russian olive seeds | 5.3 (2) | | |
| Nightshade | 7.9 (3) | | |
| Apple | 5.3 (2) | | |
| Corn | 2.6 (1) | | |
| Grass | 15.8 (6) | | |
| Miscellaneous vegetation | 31.6 (12) | | |
| INORGANIC | 29.0 (11) | | |

Table 4. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 46 coyote scats collected on the Snake River Birds of Prey Study Area, December 1976 to February 1977. The total number of identified mammalian prey items was 79. Sample sizes are in parentheses. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 19.6 (9) | 11.4 (9) | 57.9 |
| Cottontail rabbit | 6.5 (3) | 3.4 (3) | 5.9 |
| Unknown lagomorph | 10.9 (5) | 6.3 (5) | 23.8 |
| Townsend ground squirrel | 28.3 (13) | 22.8 (18) | 9.4 |
| Mountain vole | 28.3 (13) | 30.4 (24) | 2.2 |
| Kangaroo rat | 6.5 (3) | 5.1 (4) | Tr |
| Deer mouse | 2.2 (1) | 1.3 (1) | Tr |
| Townsend pocket gopher | 2.2 (1) | 3.4 (3) | |
| Harvest mouse | 2.2 (1) | 1.3 (1) | |
| Desert wood rat | 2.2 (1) | 1.3 (1) | |
| House mouse | 2.2 (1) | 1.3 (1) | |
| Pocket mouse | 2.2 (1) | 1.3 (1) | |
| Marmot | 2.2 (1) | 1.3 (1) | |
| Coyote | 2.2 (1) | 1.3 (1) | |
| Domestic cow | 6.5 (3) | 3.4 (3) | |
| Domestic horse | 2.2 (1) | 1.3 (1) | |
| Unknown mammal | 4.4 (2) | 2.5 (2) | |
| AVIAN | | | |
| Starling | 2.2 (1) | | |
| Unknown bird | 4.4 (2) | | |
| FISH | | | |
| Unknown cyprinid | 2.2 (1) | | |
| REPTILE | | | |
| Striped whipsnake | 2.2 (1) | | |
| INVERTEBRATE | | | |
| Beetles | 2.2 (1) | | |
| Snail | 2.2 (1) | | |
| PLANT | | | |
| Sugar beets | 6.5 (3) | | |
| Grass | 19.6 (9) | | |
| Miscellaneous vegetation | 8.7 (4) | | |
| INORGANIC | 4.4 (2) | | |

Table 5. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 26 coyote scats collected on the Snake River Birds of Prey Study Area, March 1977. The total number of identified mammalian prey items was 38. Sample sizes are in parentheses. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 30.8 (8) | 21.1 (8) | 61.3 |
| Cottontail rabbit | 7.7 (2) | 5.3 (2) | 5.2 |
| Unknown lagomorph | 15.4 (4) | 10.5 (4) | 25.6 |
| Townsend ground squirrel | 26.9 (7) | 32.4 (11) | 7.4 |
| Mountain vole | 11.5 (3) | 7.9 (3) | Tr |
| Kangaroo rat | 7.7 (2) | 7.9 (3) | Tr |
| Deer mouse | 3.8 (1) | 2.6 (1) | Tr |
| House mouse | 3.8 (1) | 2.6 (1) | |
| Pocket mouse | 3.8 (1) | 2.6 (1) | |
| Unknown cricetid | 3.8 (1) | 2.6 (1) | |
| Domestic cow | 15.4 (4) | 10.5 (4) | |
| AVIAN | | | |
| Mourning dove | 3.8 (1) | | |
| Unknown bird | 11.5 (3) | | |
| INVERTEBRATE | | | |
| Grasshopper | 3.8 (1) | | |
| PLANT | | | |
| Corn | 3.8 (1) | | |
| Miscellaneous vegetation | 3.8 (1) | | |

Table 6. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 48 coyote scats collected on the Snake River Birds of Prey Study Area, April 1977. The total number ofidentified mammalian prey items was 101. Relative percent biomass estimated for scats collected north of the Snake River only due to small sample size (ten scats) south of the river. Sample sizes are in parentheses; the left number is for scats collected north of the river and the right number is for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 33.3 (13,3) | 16.8 (14,3) | 57.9 |
| Cottontail rabbit | 8.3 (4,0) | 5.0 (5,0) | 7.0 |
| Unknown lagomorph | 18.8 (8,1) | 8.9 (8,1) | 25.2 |
| Townsend ground squirrel | 43.8 (20,1) | 24.8 (24,1) | 8.7 |
| Mountain vole | 25.0 (7,5) | 21.8 (9,13) | Tr |
| Kangaroo rat | 18.8 (5,4) | 8.9 (5,4) | Tr |
| Deer mouse | 6.3 (2,1) | 3.0 (2,1) | |
| Unknown woodrat | 4.2 (1,1) | 2.0 (1,1) | |
| Bushy-tailed woodrat | 2.1 (1,0) | 1.0 (1,0) | |
| Pocket mouse | 4.2 (1,1) | 3.0 (1,2) | |
| Marmot | 2.1 (1,0) | 1.0 (1,0) | |
| Unknown cricetid | 2.1 (1,0) | 1.0 (1,0) | |
| Domestic cow | 6.3 (2,1) | 3.0 (2,1) | |
| AVIAN | | | |
| Unknown bird | 4.2 (1,1) | | |
| INVERTEBRATE | | | |
| Beetles | 10.4 (4,1) | | |
| PLANT | | | |
| Unknown seeds | 2.1 (0,1) | | |
| Sagebrush | 2.1 (1,0) | | |
| Grass | 2.1 (0,1) | | |
| Miscellaneous vegetation | 2.1 (0,1) | | |
| INORGANIC | 2.1 (0,1) | | |

Table 7. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 35 coyote scats collected on the Snake River Birds of Prey Study Area, May 1977. The total number of identified mammalian prey items was 75. Relative percent biomass estimated for scats collected north of the Snake River only due to small sample size (12 scats) south of the river. Sample sizes are in parentheses; the left number is for scats collected north of the river and the right number is for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequence of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 37.1 (11,2) | 17.3 (11,2) | 82.2 |
| Cottontail rabbit | 8.6 (2,1) | 4.0 (2,1) | 5.0 |
| Unknown lagomorph | 14.3 (1,4) | 6.7 (1,4) | 6.6 |
| Townsend ground squirrel | 25.7 (7,2) | 12.0 (7,2) | 4.7 |
| Mountain vole | 20.0 (1,6) | 21.3 (1,15) | Tr |
| Kangaroo rat | 34.3 (7,5) | 17.3 (7,6) | 1.4 |
| Deer mouse | 2.9 (0,1) | 1.3 (0,1) | Tr |
| Unknown pocket gopher | 11.4 (1,3) | 6.7 (2,3) | |
| Townsend pocket gopher | 2.9 (0,1) | 1.3 (0,1) | |
| Harvest mouse | 2.9 (1,0) | 1.3 (1,0) | |
| Pocket mouse | 11.4 (1,3) | 6.7 (2,3) | |
| Badger | 5.7 (2,0) | 2.7 (2,0) | |
| Domestic cow | 2.9 (1,0) | 1.3 (1,0) | |
| AVIAN | | | |
| Unknown bird | 5.7 (1,1) | | |
| FISH | | | |
| Unknown fish | 2.9 (0,1) | | |
| REPTILE | | | |
| Striped whipsnake | 5.7 (1,1) | | |
| INVERTEBRATE | | | |
| Beetles | 22.9 (5,3) | | |
| Grasshopper | 2.9 (1,0) | | |
| Scorpion | 5.7 (2,0) | | |
| PLANT | | | |
| Sugar beet | 2.9 (0,1) | | |
| Grass | 2.9 (0,1) | | |
| INORGANIC | 2.9 (1,0) | | |

Table 8. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 169 coyote scats collected on the Snake River Birds of Prey Study Area, March 1977 to May 1977. The total number of identified mammalian prey items was 318. Sample sizes are in parentheses. NS stands for scats collected north of the Snake River; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Freqeuncy of occurrence | | Percent identified items | | Percent biomass | | |
|---|---|---|---|---|---|---|---|
| | NS (124) | SS (45) | NS (207) | SS (111) | NS | SS | Combined |
| MAMMAL | | | | | | | |
| Black-tailed jackrabbit | 36.3 (45) | 26.7 (12) | 22.2 (46) | 11.7 (13) | 62.8 | 55.6 | 61.0 |
| Cottontail rabbit | 7.3 (9) | 4.4 (2) | 4.8 (10) | 1.8 (2) | 4.6 | 2.9 | 4.2 |
| Unknown lagomorph | 16.9 (21) | 15.6 (7) | 10.2 (21) | 6.3 (7) | 25.1 | 26.9 | 26.0 |
| Townsend ground squirrel | 37.1 (46) | 8.9 (4) | 26.1 (54) | 6.3 (7) | 6.5 | 2.6 | 5.5 |
| Mountain vole | 12.1 (15) | 33.3 (15) | 8.2 (17) | 32.4 (36) | Tr | 2.4 | Tr |
| Kangaroo rat | 12.1 (15) | 35.6 (16) | 7.7 (16) | 16.2 (18) | Tr | 2.0 | Tr |
| Deer mouse | 4.8 (6) | 4.4 (2) | 3.4 (7) | 1.8 (2) | Tr | Tr | Tr |
| Unknown pocket gopher | Tr (1) | 13.3 (6) | Tr (1) | 11.7 (13) | Tr | 7.5 | 1.8 |
| Townsend pocket gopher | 0.0 (0) | 2.2 (1) | 0.0 (0) | Tr (1) | | | |
| Harvest mouse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown woodrat | Tr (1) | 2.2 (1) | Tr (1) | Tr (1) | | | |
| Bushy-tailed woodrat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| House mouse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Pocket mouse | 6.5 (8) | 13.3 (6) | 4.3 (9) | 6.3 (7) | | | |
| Marmot | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Muskrat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown cricetid | 3.2 (4) | 2.2 (1) | 1.9 (4) | Tr (1) | | | |
| Coyote | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Badger | 1.6 (2) | 0.0 (0) | 1.0 (2) | 0.0 (0) | | | |
| Domestic cow | 10.5 (13) | 6.7 (3) | 6.3 (13) | 2.7 (3) | | | |
| AVIAN | | | | | | | |
| Mourning dove | Tr (1) | 0.0 (0) | | | | | |
| Pheasant | Tr (1) | 0.0 (0) | | | | | |
| Unknown bird | 4.8 (6) | 6.7 (3) | | | | | |

Table 8. *Continued.*

| Groups and species | Frequency of occurrence | | Percent identified items | | Percent biomass | | |
|---|---|---|---|---|---|---|---|
| | NS (124) | SS (45) | NS (207) | SS (111) | NS | SS | Combined |
| FISH | | | | | | | |
| Sucker | 0.0 (0) | 2.2 (1) | | | | | |
| Unknown fish | 0.0 (0) | 2.2 (1) | | | | | |
| REPTILE | | | | | | | |
| Striped whipsnake | Tr (1) | 6.7 (3) | | | | | |
| INVERTEBRATE | | | | | | | |
| Beetles | 12.1 (15) | 13.3 (6) | | | | | |
| Grasshopper | 1.6 (2) | 2.2 (1) | | | | | |
| Scorpion | 2.4 (3) | 0.0 (0) | | | | | |
| Diptera larvae | 0.0 (0) | 2.2 (1) | | | | | |
| PLANT | | | | | | | |
| Unknown seeds | 1.6 (2) | 2.2 (1) | | | | | |
| Sugar beets | 1.6 (2) | 0.0 (0) | | | | | |
| Corn | Tr (1) | 0.0 (0) | | | | | |
| Sagebrush | Tr (1) | 0.0 (0) | | | | | |
| Grass | Tr (1) | 4.4 (2) | | | | | |
| Miscellaneous vegetation | 1.6 (2) | 4.4 (2) | | | | | |
| INORGANIC | 4.0 (5) | 2.2 (1) | | | | | |

Table 9. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 86 coyote scats collected on the Snake River Birds of Prey Study Area, June 1977. The total number of identified mammalian prey items was 122. Relative percent biomass estimated for scats collected north of the Snake River only due to small sample size (12 scats) south of the river. Sample sizes are in parentheses; the left number is for scats collected north of the river, and the right number is for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 27.9 (22,2) | 19.8 (22,2) | 80.2 |
| Cottontail rabbit | 11.6 (9,1) | 8.2 (9,1) | 11.1 |
| Unknown lagomorph | 2.3 (1,1) | 1.6 (1,1) | 2.7 |
| Townsend ground squirrel | 19.8 (12,5) | 15.6 (13,6) | 4.2 |
| Mountain vole | 8.1 (4,3) | 9.8 (7,5) | Tr |
| Unknown kangaroo rat | 14.0 (9,3) | 13.1 (13,3) | 1.3 |
| Ord's kangaroo rat | 1.2 (1,0) | Tr (1,0) | |
| Deer mouse | 3.5 (2,1) | 3.3 (3,1) | Tr |
| Pocket gopher | 3.5 (1,2) | 5.7 (1,6) | |
| Unknown woodrat | 1.2 (1,0) | Tr (1,0) | |
| Bushy-tailed woodrat | 1.2 (1,0) | Tr (1,0) | |
| Grasshopper mouse | 1.2 (1,0) | Tr (1,0) | |
| Muskrat | 1.2 (1,0) | Tr (1,0) | |
| Unknown cricetid | 1.2 (0,1) | Tr (0,1) | |
| Unknown rodent | 1.2 (1,0) | Tr (1,0) | |
| Coyote | 3.5 (3,0) | 2.5 (3,0) | |
| Spotted skunk | 1.2 (1,0) | Tr (1,0) | |
| Badger | 2.3 (2,0) | 1.6 (2,0) | |
| Domestic cow | 10.5 (9,0) | 7.4 (9,0) | |
| Domestic horse | 1.2 (1,0) | Tr (1,0) | |
| Domestic dog | 1.2 (1,0) | Tr (1,0) | |
| Antelope | 1.2 (1,0) | Tr (1,0) | |
| Unknown bat | 1.2 (1,0) | Tr (1,0) | |
| Unknown mammal | 2.3 (2,0) | 1.6 (2,0) | |

Table 9. *Continued.*

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| AVIAN | | | |
| Magpie | 1.2 (0,1) | | |
| Pheasant | 1.2 (1,0) | | |
| Bird eggshells | 1.2 (1,0) | | |
| Unknown bird | 4.7 (4,0) | | |
| FISH | | | |
| Unknown | 1.2 (1,0) | | |
| REPTILE | | | |
| Collared lizard | 1.2 (1,0) | | |
| Western whiptail lizard | 3.5 (3,0) | | |
| Desert horned lizard | 1.2 (1,0) | | |
| Side-blotched lizard | 1.2 (1,0) | | |
| Unknown lizard | 1.2 (0,1) | | |
| Gopher snake | 1.2 (1,0) | | |
| Western rattlesnake | 2.3 (1,1) | | |
| Unknown snake | 3.5 (3,0) | | |
| INVERTEBRATE | | | |
| Beetles | 12.8 (9,2) | | |
| Grasshopper | 11.6 (9,1) | | |
| Scorpion | 10.5 (8,1) | | |
| Crayfish | 1.2 (1,0) | | |
| PLANT | | | |
| Goosefoot family | 3.5 (3,0) | | |
| Orange peel | 1.2 (1,0) | | |
| Grass | 1.2 (0,1) | | |
| Miscellaneous vegetation | 1.2 (1,0) | | |
| INORGANIC | 14.0 (12,0) | | |

Table 10. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 143 coyote scats collected on the Snake River Birds of Prey Study Area, July 1977. The total number of identified mammalian prey items was 171. Sample sizes are in parentheses; the left number is for scats collected north of the Snake River and the right number is for scats collected south of the river. NS stands for scats collected north of the river; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass NS | SS | combined |
|---|---|---|---|---|---|
| MAMMAL | | | | | |
| Black-tailed jackrabbit | 36.4 (42,10) | 31.6 (44,10) | 85.8 | 80.0 | 85.0 |
| Cottontail rabbit | 9.1 (10,3) | 7.6 (10,3) | 6.6 | 8.1 | 6.9 |
| Unknown lagomorph | 2.1 (2,1) | 1.8 (2,1) | 3.3 | 6.4 | 3.9 |
| Townsend ground squirrel | 9.1 (12,1) | 11.7 (19,1) | 3.2 | Tr | 2.8 |
| Mountain vole | 2.8 (3,1) | 2.9 (4,1) | Tr | Tr | Tr |
| Unknown kangaroo rat | 8.4 (6,6) | 12.3 (9,12) | Tr | 2.7 | Tr |
| Ord's kangaroo rat | 1.4 (1,1) | 1.2 (1,1) | | | |
| Deer mouse | 9.8 (14,0) | 12.3 (21,0) | Tr | Tr | Tr |
| Unknown pocket gopher | Tr (0,1) | Tr (0,1) | | | |
| Townsend pocket gopher | Tr (0,1) | Tr (0,1) | | | |
| Northern pocket gopher | Tr (1,0) | Tr (1,0) | | | |
| Harvest mouse | 2.8 (3,1) | 3.5 (4,2) | | | |
| Woodrat | 2.1 (2,1) | 1.8 (2,1) | | | |
| Pocket mouse | 1.4 (2,0) | 1.2 (2,0) | | | |
| Marmot | 2.1 (3,0) | 1.8 (3,0) | | | |
| White-tailed antelope squirrel | Tr (1,0) | Tr (1,0) | | | |
| Least chipmunk | Tr (1,0) | Tr (1,0) | | | |
| Unknown sciurid | Tr (0,1) | Tr (0,1) | | | |
| Unknown cricetid | 1.4 (1,1) | 1.2 (1,1) | | | |
| Badger | Tr (1,0) | Tr (1,0) | | | |
| Unknown shrew | Tr (0,1) | Tr (0,1) | | | |
| Domestic cow | 4.2 (4,2) | 3.5 (4,2) | | | |
| Domestic cat | Tr (0,1) | Tr (0,1) | | | |
| Unknown mammal | Tr (1,0) | Tr (1,0) | | | |

Table 10. *Continued.*

| | | | Percent biomass | | |
|---|---|---|---|---|---|
| Groups and species | Frequency of occurrence | Percent identified items | NS | SS | Combined |
| AVIAN | | | | | |
| Bird eggshells | Tr (1,0) | | | | |
| Unknown bird | 1.4 (1,1) | | | | |
| FISH | | | | | |
| Sucker | 1.4 (2,0) | | | | |
| Unknown cyprinid | 1.4 (1,1) | | | | |
| Unknown fish | 1.4 (2,0) | | | | |
| REPTILE | | | | | |
| Western whiptail lizard | Tr (0,1) | | | | |
| Desert horned lizard | Tr (1,0) | | | | |
| Unknown lizard | Tr (1,0) | | | | |
| Gopher snake | 3.5 (4,1) | | | | |
| Striped whipsnake | 3.5 (3,2) | | | | |
| Western rattlesnake | Tr (0,1) | | | | |
| Unknown snake | Tr (1,0) | | | | |
| Reptile eggs | Tr (1,0) | | | | |
| INVERTEBRATE | | | | | |
| Beetles | 9.1 (9,4) | | | | |
| Grasshopper | 16.1 (21,2) | | | | |
| Scorpion | 11.2 (10,6) | | | | |
| PLANT | | | | | |
| Wheat seeds | Tr (0,1) | | | | |
| Conifer nuts | Tr (1,0) | | | | |
| Cotton | Tr (1,0) | | | | |
| Grass | 8.4 (11,1) | | | | |
| Miscellaneous vegetation | 5.6 (6,2) | | | | |
| INORGANIC | 9.8 (11,3) | | | | |

Table 11. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 155 coyote scats collected on the Snake River Birds of Prey Study Area, August 1977. The total number of identified mammalian prey items was 192. Sample sizes are in parentheses; the left number is for scats collected north of the Snake River, and the right number is for scats collected south of the river. NS stands for scats collected north of the river; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass<br>NS | <br>SS | <br>Combined |
|---|---|---|---|---|---|
| MAMMAL | | | | | |
| Black-tailed jackrabbit | 31.6 (42,7) | 26.0 (43,7) | 83.7 | 79.9 | 83.1 |
| Cottontail rabbit | 7.1 (10,1) | 5.7 (10,1) | 6.6 | 3.9 | 6.2 |
| Unknown lagomorph | 1.9 (2,1) | 1.6 (2,1) | 3.3 | 10.3 | 4.3 |
| Townsend ground squirrel | 14.8 (20,3) | 16.7 (27,5) | 4.7 | 5.1 | 4.8 |
| Mountain vole | 7.7 (11,1) | 7.3 (13,1) | Tr | Tr | Tr |
| Unknown kangaroo rat | 10.3 (13,3) | 13.0 (19,6) | 1.2 | Tr | 1.1 |
| Ord's kangaroo rat | 2.6 (4,0) | 2.1 (4,0) | | | |
| Deer mouse | 5.8 (8,1) | 6.8 (12,1) | Tr | Tr | Tr |
| Pocket gopher | 1.3 (2,0) | 1.0 (2,0) | | | |
| Harvest mouse | 1.3 (2,0) | 1.6 (3,0) | | | |
| Unknown woodrat | Tr (1,0) | Tr (1,0) | | | |
| Desert woodrat | Tr (1,0) | Tr (1,0) | | | |
| Bushy-tailed woodrat | Tr (1,0) | Tr (1,0) | | | |
| Pocket mouse | 2.6 (3,1) | 2.6 (4,1) | | | |
| Marmot | 1.9 (3,0) | 1.6 (3,0) | | | |
| Unknown cricetid | 1.3 (2,0) | 1.0 (2,0) | | | |
| Unknown microtine | Tr (1,0) | Tr (1,0) | | | |
| Coyote | Tr (1,0) | Tr (1,0) | | | |
| Striped skunk | Tr (1,0) | Tr (1,0) | | | |
| Badger | 2.6 (4,0) | 2.1 (4,0) | | | |
| Domestic cow | 7.7 (11,1) | 6.3 (11,1) | | | |
| Domestic sheep | Tr (1,0) | Tr (1,0) | | | |
| Domestic cat | Tr (0,1) | Tr (0,1) | | | |
| Domestic dog | Tr (1,0) | Tr (1,0) | | | |

Table 11. *Continued.*

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass NS | Percent biomass SS | Percent biomass Combined |
|---|---|---|---|---|---|
| AVIAN | | | | | |
| California quail | Tr (0,1) | | | | |
| Pheasant | 1.3 (1,1) | | | | |
| Unknown bird | 6.5 (8,2) | | | | |
| FISH | | | | | |
| Crappie | Tr (0,1) | | | | |
| Unknown cyprinid | Tr (1,0) | | | | |
| Unknown fish | 3.2 (5,0) | | | | |
| REPTILE | | | | | |
| Western whiptail lizard | 1.9 (3,0) | | | | |
| Side-blotched lizard | Tr (1,0) | | | | |
| Leopard lizard | Tr (1,0) | | | | |
| Gopher snake | 3.9 (5,1) | | | | |
| Striped whipsnake | 2.6 (3,1) | | | | |
| Unknown snake | Tr (1,0) | | | | |
| Unknown reptile eggs | Tr (1,0) | | | | |
| INVERTEBRATE | | | | | |
| Beetles | 12.9 (15,5) | | | | |
| Grasshopper | 38.1 (47,12) | | | | |
| Scorpion | 4.5 (6,1) | | | | |
| PLANT | | | | | |
| Russian olive seeds | Tr (1,0) | | | | |
| Hackberry seeds | Tr (1,0) | | | | |
| Corn | 1.9 (2,1) | | | | |
| Sugar beet | Tr (1,0) | | | | |
| Wheat | Tr (1,0) | | | | |
| Grass | 14.2 (22,0) | | | | |
| Miscellaneous vegetation | 10.3 (13,3) | | | | |
| INORGANIC | 12.3 (15,4) | | | | |

Table 12. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 384 coyote scats collected on the Snake River Birds of Prey Study Area, June 1977 to August 1977. The total number of identified mammalian prey items was 480. Sample sizes are in parentheses. NS stands for scats collected north of the Snake River; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and speices | Frequency of occurrence NS (319) | Frequency of occurrence SS (65) | Percent identified items NS (392) | Percent identified items SS (88) | Percent biomass NS | Percent biomass SS | Percent biomass Combined |
|---|---|---|---|---|---|---|---|
| MAMMAL | | | | | | | |
| Black-tailed jackrabbit | 33.2 (106) | 29.2 (19) | 27.8 (109( | 21.6 (19) | 83.8 | 76.8 | 83.0 |
| Cottontail rabbit | 9.1 (29) | 7.7 (5) | 7.4 (29) | 5.7 (5) | 7.5 | 6.8 | 7.4 |
| Unknown lagomorph | 1.6 (5) | 4.6 (3) | 1.3 (5) | 3.4 (3) | 3.2 | 9.6 | 3.8 |
| Townsend ground squirrel | 14.1 (45) | 13.9 (9) | 15.1 (59) | 13.6 (12) | 4.0 | 4.3 | 4.1 |
| Mountain vole | 5.6 (18) | 7.7 (5) | 6.1 (24) | 8.0 (7) | Tr | Tr | Tr |
| Unknown kangaroo rat | 8.8 (28) | 18.5 (12) | 10.5 (41) | 23.9 (21) | Tr | 1.9 | 1.2 |
| Ord's kangaroo rat | 1.9 (6) | 1.5 (1) | 1.5 (6) | 1.1 (1) | | | |
| Deer mouse | 7.5 (24) | 3.1 (2) | 9.2 (36) | 2.3 (2) | Tr | Tr | Tr |
| Unknown pocket gopher | Tr (3) | 4.6 (3) | Tr (3) | 8.0 (7) | | | |
| Townsend pocket gopher | 0.0 (0) | 1.5 (1) | 0.0 (0) | 1.1 (1) | | | |
| Northern pocket gopher | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Harvest mouse | 1.6 (5) | 1.5 (1) | 1.8 (7) | 1.1 (1) | | | |
| Unknown woodrat | 1.3 (4) | 1.5 (1) | 1.0 (4) | 1.1 (1) | | | |
| Desert woodrat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Bushy-tailed woodrat | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Grasshopper moue | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Pocket mouse | 1.6 (5) | 1.5 (1) | 1.5 (6) | 1.1 (1) | | | |
| Muskrat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Marmot | 1.9 (6) | 0.0 (0) | 1.5 (6) | 0.0 (0) | | | |
| White-tailed antelope ground squirrel | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Least chipmunk | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown sciurid | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown cricetid | Tr (3) | 3.1 (2) | Tr (3) | 2.3 (2) | | | |
| Unknown microtine | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown rodent | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Coyote | 1.3 (4) | 0.0 (0) | 1.0 (4) | 0.0 (0) | | | |

Table 12. *Continued.*

| Groups and species | Frequency of occurrence<br>NS (319) | <br>SS (65) | Percent identified items<br>NS (392) | <br>SS (88) | Percent biomass<br>NS | <br>SS | <br>Combined |
|---|---|---|---|---|---|---|---|
| MAMMALS (*continued*) | | | | | | | |
| Spotted skunk | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Striped skunk | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Badger | 2.2 (7) | 0.0 (0) | 1.8 (7) | 0.0 (0) | | | |
| Unknown shrew | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Domestic cow | 7.5 (24) | 4.6 (3) | 6.1 (24) | 3.4 (3) | | | |
| Domestic horse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Domestic sheep | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Domestic cat | 0.0 (0) | 3.1 (2) | 0.0 (0) | 2.3 (2) | | | |
| Domestic dog | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Antelope | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown Bat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown mammal | Tr (3) | 0.0 (0) | Tr (3) | 0.0 (0) | | | |
| AVIAN | | | | | | | |
| Magpie | 0.0 (0) | 1.5 (1) | | | | | |
| California quail | 0.0 (0) | 1.5 (1) | | | | | |
| Pheasant | Tr (2) | 1.5 (1) | | | | | |
| Unknown bird | 4.1 (13) | 4.6 (3) | | | | | |
| Bird eggshells | Tr (2) | 0.0 (0) | | | | | |
| FISH | | | | | | | |
| Sucher | Tr (2) | 0.0 (0) | | | | | |
| Crappie | 0.0 (0) | 1.5 (1) | | | | | |
| Unknown cyprinid | Tr (2) | 1.5 (1) | | | | | |
| Unknown fish | 2.5 (8) | 0.0 (0) | | | | | |
| REPTILE | | | | | | | |
| Collared lizard | Tr (1) | 0.0 (0) | | | | | |
| Western whiptail lizard | 1.9 (6) | 1.5 (1) | | | | | |
| Desert horned lizard | Tr (2) | 0.0 (0) | | | | | |
| Side-blotched lizard | Tr (2) | 0.0 (0) | | | | | |

Table 12. *Continued.*

| Groups and species | Frequency of occurrence | | Percent identified items | | Percent biomass | | |
|---|---|---|---|---|---|---|---|
| | NS (319) | SS (65) | NS (392) | SS (88) | NS | SS | Combined |
| REPTILE (*continued*) | | | | | | | |
| Leopard lizard | Tr (1) | 0.0 (0) | | | | | |
| Unknown lizard | Tr (1) | 1.5 (1) | | | | | |
| Gopher snake | 3.2 (10) | 3.0 (2) | | | | | |
| Striped whipsnake | 1.9 (6) | 4.6 (3) | | | | | |
| Western rattlesnake | Tr (1) | 3.1 (2) | | | | | |
| Unknown snake | 1.6 (5) | 0.0 (0) | | | | | |
| Reptile eggshells | Tr (2) | 0.0 (0) | | | | | |
| INVERTEBRATE | | | | | | | |
| Beetles | 10.3 (33) | 16.9 (11) | | | | | |
| Grasshopper | 24.1 (77) | 23.1 (15) | | | | | |
| Scorpion | 7.5 (24) | 12.3 (8) | | | | | |
| Crayfish | Tr (1) | 0.0 (0) | | | | | |
| PLANT | | | | | | | |
| Russian olive seeds | Tr (1) | 0.0 (0) | | | | | |
| Hackberry seeds | Tr (1) | 0.0 (0) | | | | | |
| Corn | Tr (2) | 1.5 (1) | | | | | |
| Sugar beet | Tr (1) | 0.0 (0) | | | | | |
| Wheat | Tr (1) | 1.5 (1) | | | | | |
| Conifer nuts | Tr (1) | 0.0 (0) | | | | | |
| Cotton | Tr (1) | 0.0 (0) | | | | | |
| Goosefoot family | Tr (3) | 0.0 (0) | | | | | |
| Orange peel | Tr (1) | 0.0 (0) | | | | | |
| Grass | 10.3 (33) | 3.1 (2) | | | | | |
| Miscellaneous vegetation | 6.3 (20) | 7.7 (5) | | | | | |
| INORGANIC | 11.9 (38) | 10.8 (7) | | | | | |

Table 13. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 178 coyote scats collected on the Snake River Birds of Prey Study Area, September 1977. The total number of identified mammalian prey items was 205. Sample sizes are in parentheses; the left number is for scats collected north of the Snake River, and the right number is for scats collected south of the river. NS stands for scats collected north of the river; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass | | |
|---|---|---|---|---|---|
| | | | NS | SS | Combined |
| MAMMAL | | | | | |
| Black-tailed jackrabbit | 24.7 (35,7,2)[a] | 22.4 (35,9,2) | 85.8 | 90.8 | 86.8 |
| Cottontail rabbit | 5.1 (8,1) | 4.4 (8,1) | 6.0 | 3.1 | 5.2 |
| Unknown lagomorph | Tr (1,0) | Tr (1,0) | 2.1 | Tr | 1.6 |
| Townsend ground squirrel | 8.4 (11,4) | 13.2 (21,6) | 4.2 | 2.2 | 4.2 |
| Mountain vole | 2.8 (4,1) | 7.8 (15,1) | Tr | Tr | Tr |
| Unknown kangaroo rat | 9.0 (10,6) | 13.2 (16,11) } | 1.2 | 2.9 | 1.4 |
| Ord's kangaroo rat | 1.7 (2,1) | 2.4 (4,1) | | | |
| Deer mouse | 6.2 (7,4) | 9.3 (9,10) | Tr | 1.0 | Tr |
| Unknown pocket gopher | Tr (0,1) | Tr (0,1) | | | |
| Northern pocket gopher | Tr (1,0) | Tr (1,0) | | | |
| Unknown woodrat | 2.5 (1,3) | 2.9 (1,5) | | | |
| Desert woodrat | Tr (1,0) | Tr (1,0) | | | |
| Bushy-tailed woodrat | Tr (1,0) | Tr (1,0) | | | |
| House mouse | Tr (1,0) | Tr (1,0) | | | |
| Grasshopper mouse | Tr (1,0) | Tr (1,0) | | | |
| Pocket mouse | Tr (1,0) | Tr (1,0) | | | |
| Muskrat | Tr (1,0) | Tr (1,0) | | | |
| Marmot | 1.1 (2,0) | 1.0 (2,0) | | | |
| Porcupine | Tr (1,0) | Tr (1,0) | | | |
| Least chipmunk | Tr (1,0) | Tr (1,0) | | | |
| Unknown sciurid | 1.1 (1,1) | 1.0 (1,1) | | | |
| Unknown cricetid | Tr (1,0) | Tr (1,0) | | | |
| Unknown microtine | 1.7 (1,2) | 1.5 (1,2) | | | |
| Unknown rodent | Tr (1,0) | Tr (1,0) | | | |
| Coyote | 2.8 (5,0) | 2.4 (5,0) | | | |
| Striped skunk | Tr (1,0) | Tr (1,0) | | | |

Table 13. *Continued.*

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass | | |
|---|---|---|---|---|---|
| | | | NS | SS | Combined |
| MAMMAL (*continued*) | | | | | |
| Long-tailed weasel | Tr (1,0) | Tr (1,0) | | | |
| Raccoon | Tr (1,0) | Tr (1,0) | | | |
| Badger | 1.1 (2,0) | 1.0 (2,0) | | | |
| Domestic cow | 6.7 (10,2) | 5.9 (10,2) | | | |
| Domestic sheep | Tr (1,0) | Tr (1,0) | | | |
| Domestic pig | Tr (1,0) | Tr (1,0) | | | |
| Domestic cat | Tr (1,0) | Tr (1,0) | | | |
| Domestic dog | 1.1 (2,0) | 1.9 (2,0) | | | |
| Mule deer | Tr (1,0) | Tr (1,0) | | | |
| Unknown bat | Tr (1,0) | Tr (1,0) | | | |
| Unknown mammal | Tr (1,0) | Tr (1,0) | | | |
| AVIAN | | | | | |
| Mourning dove | Tr (1,0) | | | | |
| Pheasant | Tr (1,0) | | | | |
| Unknown duck | Tr (1,0) | | | | |
| Unknown bird | 3.4 (3,3) | | | | |
| FISH | | | | | |
| Unknown centrarchid | Tr (1,0) | | | | |
| Unknown fish | Tr (1,0) | | | | |
| REPTILE | | | | | |
| Unknown lizard | Tr (1,0) | | | | |
| Gopher snake | 1.7 (3,0) | | | | |
| Racer snake | Tr (1,0) | | | | |
| Western rattlesnake | 1.1 (1,1) | | | | |
| Unknown snake | Tr (1,0) | | | | |

Table 13. *Continued.*

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass<br>NS | <br>SS | <br>Combined |
|---|---|---|---|---|---|
| INVERTEBRATE | | | | | |
| Beetles | 14.1 (22,3) | | | | |
| Grasshopper | 24.2 (40,3) | | | | |
| Scorpion | 1.7 (2,1) | | | | |
| PLANT | | | | | |
| Nightshade seeds | 3.4 (5,1) | | | | |
| Hackberry seeds | Tr (1,0) | | | | |
| Peach pits | Tr (1,0) | | | | |
| Wheat | 1.1 (1,1) | | | | |
| Apple | Tr (1,0) | | | | |
| Corn | 10.1 (9,5,4)[a] | | | | |
| Grass | 5.6 (1,1) | | | | |
| Miscellaneous vegetation | 5.6 (4,6) | | | | |
| INORGANIC | 9.6 (12,5) | | | | |

[a] Several scats and colon samples were collected in September 1977 for which the location of collection was not recorded (i.e., north of the river vs south of the river). Black-tailed jackrabbit and corn were discovered in those scats and those results are included in this table. Sample sizes of the additional collections are indicated by the far right number in the parentheses associated with black-tailed jackrabbit and corn.

Table 14. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 89 coyote scats collected on the Snake River Birds of Prey Study Area, October 1977. The total number of identified mammalian prey was 116. Relative percent biomass estimated for scats collected north of the river only due to small sample size (five scats) south of the river. Sample sizes in parentheses. (Tr: Trace < 1.0%).

| Group and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 31.5 (28) | 25.0 (29) | 93.1 |
| Cottontail rabbit | 3.4 (3) | 3.5 (4) | 2.0 |
| Townsend ground squirrel | 12.4 (11) | 12.1 (14) | 3.4 |
| Mountain vole | 5.6 (5) | 8.6 (10) | Tr |
| Unknown kangaroo rat | 5.6 (5) | 7.8 (9) | Tr |
| Ord's kangaroo rat | 1.1 (1) | Tr (1) | |
| Deer mouse | 9.0 (8) | 12.1 (14) | Tr |
| Pocket gopher | 1.1 (1) | Tr (1) | |
| Harvest mouse | 1.1 (1) | 1.7 (2) | |
| Unknown woodrat | 3.4 (3) | 3.5 (4) | |
| Desert woodrat | 1.1 (1) | Tr (1) | |
| Bushy-tailed woodrat | 1.1 (1) | Tr (1) | |
| Grasshopper mouse | 1.1 (1) | Tr (1) | |
| Marmot | 1.1 (1) | Tr (1) | |
| Beaver | 1.1 (1) | Tr (1) | |
| Unknown sciurid | 1.1 (1) | Tr (1) | |
| Unknown microtine | 1.1 (1) | Tr (1) | |
| Coyote | 4.5 (4) | 3.5 (4) | |
| Badger | 2.3 (2) | 1.7 (2) | |
| Domestic cow | 11.2 (10) | 8.6 (10) | |
| Domestic cat | 1.1 (1) | Tr (1) | |
| Domestic dog | 2.3 (2) | 1.7 (2) | |
| Mule deer | 1.1 (1) | Tr (1) | |
| Unknown mammal | 1.1 (1) | Tr (1) | |
| AVIAN | | | |
| Rock dove | 1.1 (1) | | |
| California quail | 1.1 (1) | | |
| Pheasant | 2.3 (2) | | |
| Chukar | 1.1 (1) | | |
| Unknown bird | 3.4 (3) | | |
| Bird eggshells | 1.1 (1) | | |
| REPTILE | | | |
| Side-blotched lizard | 1.1 (1) | | |
| Gopher snake | 1.1 (1) | | |
| Western rattlesnake | 1.1 (1) | | |

Table 14. *Continued.*

| Group and species | Frequency of occurrence | Percent identified Items | Percent biomass |
|---|---|---|---|
| INVERTEBRATE | | | |
| Beetles | 16.9 (15) | | |
| Grasshopper | 30.3 (27) | | |
| Scorpion | 2.3 (2) | | |
| PLANT | | | |
| Russian olive seeds | 1.1 (1) | | |
| Hackberry seeds | 1.1 (1) | | |
| Chokecherry seeds | 1.1 (1) | | |
| Nightshade seeds | 1.1 (1) | | |
| Wheat | 1.1 (1) | | |
| Corn | 9.0 (8) | | |
| Apple | 2.3 (2) | | |
| Sugar beet | 1.1 (1) | | |
| Apricot pits | 1.1 (1) | | |
| Goosefoot family | 4.5 (4) | | |
| Grass | 9.0 (8) | | |
| Miscellaneous vegetation | 7.9 (7) | | |
| INORGANIC | 14.5 (13) | | |

Table 15. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 42 coyote scats collected on the Snake River Birds of Prey Study Area, November 1977. The total number of identified mammalian prey was 58. Relative percent biomass estimated for scats collected north of the river only due to small sample size (two scats) south of the river. Sample sizes in parentheses. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence | Percent identified items | Percent biomass |
|---|---|---|---|
| MAMMAL | | | |
| Black-tailed jackrabbit | 33.3 (14) | 24.1 (14) | 91.5 |
| Cottontail rabbit | 4.8 (2) | 3.5 (2) | 4.0 |
| Townsend ground squirrel | 7.1 (3) | 8.6 (5) | 2.7 |
| Mountain vole | 11.9 (5) | 12.1 (7) | Tr |
| Kangaroo rat | 9.5 (4) | 15.5 (9) | 1.1 |
| Deer mouse | 7.1 (3) | 10.3 (6) | Tr |
| Pocket gopher | 2.4 (1) | 1.7 (1) | |
| Harvest mouse | 4.8 (2) | 5.2 (3) | |
| Norway rat | 2.4 (1) | 1.7 (1) | |
| Unknown sciurid | 2.4 (1) | 1.7 (1) | |
| Unknown cricetid | 2.4 (1) | 1.7 (1) | |
| Coyote | 2.4 (1) | 1.7 (1) | |
| Striped skunk | 2.4 (1) | 3.5 (2) | |
| Badger | 2.4 (1) | 1.7 (1) | |
| Domestic cow | 7.1 (3) | 5.2 (3) | |
| Domestic sheep | 2.4 (1) | 1.7 (1) | |
| AVIAN | | | |
| Unknown bird | 4.8 (2) | | |
| REPTILE | | | |
| Gopher snake | 4.8 (2) | | |
| INVERTEBRATE | | | |
| Beetles | 14.3 (6) | | |
| Grasshopper | 11.9 (5) | | |
| PLANT | | | |
| Wheat | 2.4 (1) | | |
| Corn | 4.8 (1) | | |
| Apples | 2.4 (1) | | |
| Sugar beet | 2.4 (1) | | |
| Grass | 7.1 (3) | | |
| Miscellaneous vegetation | 2.4 (1) | | |
| INORGANIC | 7.1 (3) | | |

Table 16. Frequency of occurrence, percent identified mammalian prey items, and relative percent biomass of major mammalian prey in 304 coyote scats collected on the Snake River Birds of Prey Study Area, September 1977 to November 1977. The total number of identified mammalian prey items was 370. Sample sizes are in parentheses. NS stands for scats collected north of the Snake River; SS stands for scats collected south of the river. The combined relative percent biomass column includes values from five September scats and colon samples whose collection locations were unknown. (Tr: Trace < 1.0%).

| Groups and species | Frequency of occurrence NS (264) | Frequency of occurrence SS (40) | Percent identified items NS (307) | Percent identified items SS (63) | Percent biomass NS | Percent biomass SS | Percent biomass Combined |
|---|---|---|---|---|---|---|---|
| MAMMAL | | | | | | | |
| Black-tailed jackrabbit | 29.2 (77) | 17.5 (7) | 25.4 (78) | 14.3 (9) | 89.5 | 88.9 | 89.4 |
| Cottontail rabbit | 4.9 (13) | 2.5 (1) | 4.2 (13) | 1.6 (1) | 4.2 | 6.1 | 4.3 |
| Unknown lagomorph | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | 1.0 | 0.0 | Tr |
| Townsend ground squirrel | 9.1 (24) | 12.5 (5) | 12.7 (39) | 11.1 (7) | 3.6 | 2.9 | 3.5 |
| Mountain vole | 4.9 (13) | 5.0 (2) | 9.8 (30) | 3.2 (2) | Tr | Tr | Tr |
| Unknown kangaroo rat | 6.8 (18) | 17.5 (7) | 10.4 (32) | 20.6 (13) | Tr | 3.3 | 1.1 |
| Ord's kangaroo rat | 1.1 (3) | 2.5 (1) | 1.6 (5) | 1.6 (1) | | | |
| Deer mouse | 6.4 (17) | 12.5 (5) | 8.1 (25) | 22.2 (14) | Tr | 1.3 | Tr |
| Unknown pocket gopher | Tr (1) | 5.0 (2) | Tr (1) | 4.8 (3) | | | |
| Northern pocket gopher | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Harvest mouse | Tr (2) | 2.5 (1) | 1.0 (3) | 1.6 (1) | | | |
| Unknown woodrat | 1.5 (4) | 7.5 (3) | 1.6 (5) | 7.9 (5) | | | |
| Desert woodrat | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Bushy-tailed woodrat | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Grasshopper mouse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| House mouse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Norway rat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Pocket mouse | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Muskrat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Marmot | 1.1 (3) | 0.0 (0) | 1.0 (3) | 0.0 (0) | | | |
| Beaver | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Porcupine | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Least chipmunk | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown sciurid | Tr (2) | 5.0 (2) | Tr (2) | 3.2 (2) | | | |
| Unknown cricetid | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown microtine | Tr (2) | 5.0 (2) | Tr (2) | 3.2 (2) | | | |

Table 16. *Continued.*

| Groups and species | Frequency of occurrence NS (264) | Frequency of occurrence SS (40) | Percent identified items NS (307) | Percent identified items SS (63) | Percent biomass NS | Percent biomass SS | Percent biomass Combined |
|---|---|---|---|---|---|---|---|
| MAMMAL (*continued*) | | | | | | | |
| Unknown rodent | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Coyote | 3.8 (10) | 0.0 (0) | 3.3 (10) | 0.0 (0) | | | |
| Striped skunk | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Long-tailed weasel | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Raccoon | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Badger | 1.9 (5) | 0.0 (0) | 1.6 (5) | 0.0 (0) | | | |
| Domestic cow | 8.7 (23) | 5.0 (2) | 7.5 (23) | 3.2 (2) | | | |
| Domestic sheep | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Domestic pig | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Domestic cat | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Domestic dog | 1.5 (4) | 0.0 (0) | 1.3 (4) | 0.0 (0) | | | |
| Mule deer | Tr (2) | 0.0 (0) | Tr (2) | 0.0 (0) | | | |
| Unknown bat | Tr (1) | 0.0 (0) | Tr (1) | 0.0 (0) | | | |
| Unknown mammal | Tr (1) | 2.5 (1) | Tr (1) | 1.6 (1) | | | |
| AVIAN | | | | | | | |
| Rock dove | Tr (1) | 0.0 (0) | | | | | |
| Mourning dove | Tr (1) | 0.0 (0) | | | | | |
| California quail | Tr (1) | 0.0 (0) | | | | | |
| Pheasant | 1.1 (3) | 0.0 (0) | | | | | |
| Chukar | Tr (1) | 0.0 (0) | | | | | |
| Unknown duck | Tr (1) | 0.0 (0) | | | | | |
| Unknown bird | 3.0 (8) | 7.5 (3) | | | | | |
| Bird eggshells | Tr (1) | 0.0 (0) | | | | | |
| FISH | | | | | | | |
| Unknown centrarchid | Tr (1) | 0.0 (0) | | | | | |
| Unknown fish | Tr (1) | 0.0 (0) | | | | | |

Table 16. *Continued.*

| Group and species | Frequency of occurrence | | Percent identified items | | Percent biomass | | |
|---|---|---|---|---|---|---|---|
| | NS (264) | SS (40) | NS (307) | SS (63) | NS | SS | Combined |
| REPTILE | | | | | | | |
| Side-blotched lizard | Tr (1) | 0.0 (0) | | | | | |
| Unknown lizard | Tr (1) | 0.0 (0) | | | | | |
| Gopher snake | 2.3 (6) | 0.0 (0) | | | | | |
| Racer snake | Tr (1) | 0.0 (0) | | | | | |
| Western rattlesnake | Tr (2) | 2.5 (1) | | | | | |
| Unknown snake | Tr (1) | 0.0 (0) | | | | | |
| INVERTEBRATE | | | | | | | |
| Beetles | 16.3 (43) | 7.5 (3) | | | | | |
| Grasshopper | 25.8 (68) | 17.5 (7) | | | | | |
| Scorpion | 1.5 (4) | 2.5 (1) | | | | | |
| PLANT | | | | | | | |
| Russian olive seeds | Tr (1) | 0.0 (0) | | | | | |
| Hackberry seeds | Tr (2) | 0.0 (0) | | | | | |
| Chokecherry seeds | Tr (1) | 0.0 (0) | | | | | |
| Nightshade seeds | 2.3 (6) | 2.5 (1) | | | | | |
| Wheat | 1.1 (3) | 2.5 (1) | | | | | |
| Corn | 7.2 (19) | 12.5 (5) | | | | | |
| Apple | 1.5 (4) | 0.0 (0) | | | | | |
| Sugar beet | Tr (2) | 0.0 (0) | | | | | |
| Peach pits | Tr (1) | 0.0 (0) | | | | | |
| Apricot pits | Tr (1) | 0.0 (0) | | | | | |
| Goosefoot family | 1.5 (4) | 0.0 (0) | | | | | |
| Grass | 7.2 (19) | 5.0 (2) | | | | | |
| Miscellaneous vegetation | 4.5 (12) | 15.0 (6) | | | | | |
| INORGANIC | 10.6 (28) | 12.5 (5) | | | | | |

*Spilogale putorius*), woodrats (*Neotoma* sp.), marmot (*Marmota flaviventris*), house mouse (*Mus musculus*), and coyote. Unusual mammalian prey included bats, pronghorn antelope (*Antilocapra americana*), and an unidentified shrew (*Sorex* sp.).

Avian species do not constitute an important part of the coyote's diet. Most avian remains were not identified to species. Those that were included pheasant (*Phasianus colchicus*), chukar partridge (*Alectoris graeca*), starling (*Sturnus vulgaris*), magpie (*Pica pica*), raven (*Corvus corax*), and mallard (*Anas platyrhynchos*).

Reptiles found in scats included western whiptail lizard (*Cnemidophorous tigris*), side-blotched lizard (*Uta stansburiana*), western rattlesnake (*Crotalus viridis*), gopher snake (*Pituophis melanoleucus*), and striped whipsnake (*Masticophis taeniatus*).

Beetles, grasshoppers, and scorpions were the major invertebrates consumed. It was not unusual to find scats composed entirely of grasshoppers during the late summer of 1977.

Plant material occurred in many scats. Grass, nightshade (*Solanum dulcamera*), Russian olive (*Elaegnus angustifolia*), wheat (*Triticum* sp.), and corn (*Zea mays*) were some of the more common representatives.

The fluctuation of the principal mammalian prey in the diet over time is shown in Figs. 2 and 3. There is no obvious pattern to these variations when viewed in this manner; however, if total rodent and total lagomorph are plotted (Figs. 4 and 5) it can be seen that, generally, there is an inverse relationship between the occurrence of rodents and lagomorphs.

Those mammalian species considered important enough to include in relative percent biomass calculations include black-tailed jackrabbit,

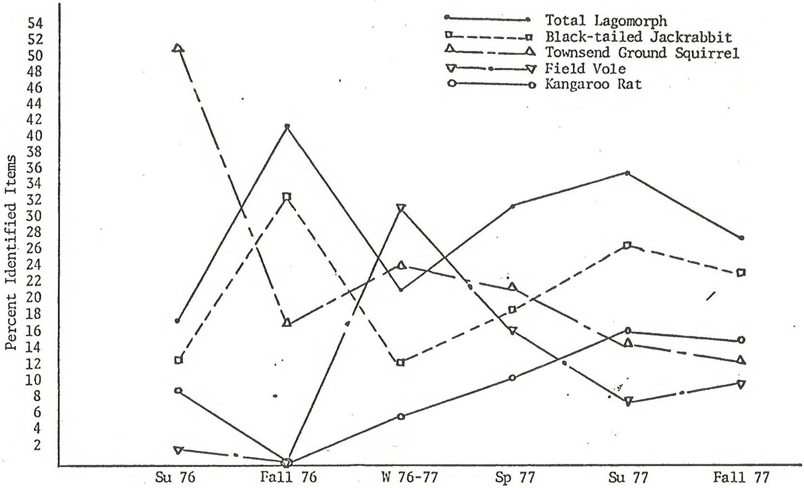

Fig. 2. Seasonal variation in the percent of selected mammalian items found in coyote scats collected on Snake River Birds of Prey Study Area.

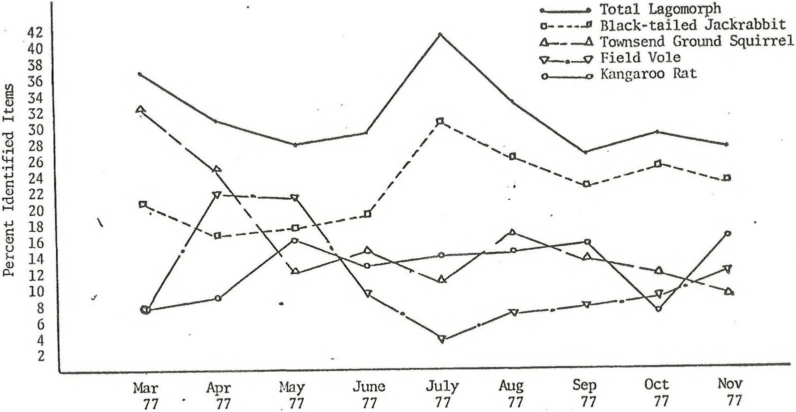

Fig. 3. Monthly variation in the percent of selected mammalian items found in coyote scats collected on the Snake River Birds of Prey Study Area.

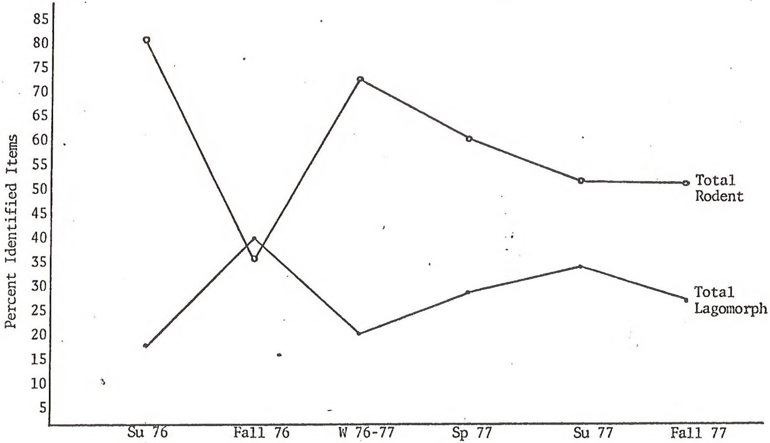

Fig. 4. Seasonal variation in the percent of total rodent and total lagomorph items found in coyote scats collected on the Snake River Birds of Prey Study Area.

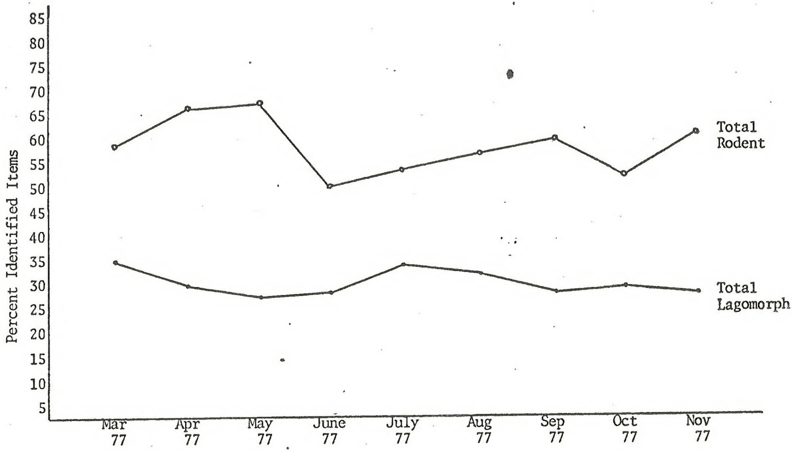

Fig. 5. Monthly variation in the percent of total rodent and total lagomorph items found in coyote scats collected on the Snake River Birds of Prey Study Area.

cottontail rabbit, unidentified lagomorph, Townsend ground squirrel, kangaroo rat, mountain vole, deer mouse, and, in some cases, pocket gophers. With the exception of the Townsend ground squirrel, all rodents generally made up less than 1 percent of relative biomass consumed by coyotes (Tables 2-16). When total consumption of all dietary items is considered these rodent species become even less important. Townsend ground squirrel typically made up between 3 and 9 percent of the relative biomass consumed. It is apparent from these results that the staple of the coyote diet on the BPSA is lagomorph, particularly black-tailed jackrabbit (Tables 2-16).

Domestic cattle appeared in a number of scats, but whether or not they represent an important source of food is unclear. Cattle were almost always consumed as carrion. There were many carcasses scattered throughout the BPSA and the systematic scat lines passed at least six of these. These carcasses continued to receive visits by coyotes long after the only thing of interest left was hide and bone. It is not known to what extent coyotes utilized these carcasses while they still had a lot of meat left on them. If the prevalence of cattle carcasses on the BPSA was as high as it seemed to be based on the number occurring on the scat lines, and if coyotes utilized them as a food source while there was still plenty of meat available then these cattle could constitute an important source of food. If coyotes visited the carcasses only infrequently, or after most of the meat was gone, then cattle would be relatively unimportant as a food source.

Most of the research conducted on the BPSA has been concentrated on the north side of the Snake River (NS). Since much of the BPSA lies south of the river (SS), an effort was made to collect coyote scats there. Generally, sample sizes SS were smaller than NS, but in a few cases a sufficient number of scats were collected SS to allow perhaps meaningful comparisons (Tables 8, 12, 16, and 17). Generally, rodents were more prevalent in SS scats than in NS scats with pocket gophers, mountain voles, and kangaroo rats being the most prevalent (Figs. 6-8). Utilization of black-tailed jackrabbit and Townsend ground squirrel typically was less on the SS than it was on the NS (Figs. 9 and 10). That Townsend ground squirrel was utilized to the extent it was on the SS is surprising. So far as is known, ground squirrels are found south of the river in only one small highly localized population (M. Kochert, personal communication). Scats containing ground squirrel were found roughly 15 km or more from this population. Clearly, however, black-tailed jackrabbit still comprises the most important dietary item of the coyote south of the river, making up 85 to 95 percent of the relative biomass consumed (Tables 8, 12, and 16).

The most puzzling result of the food habits analysis is the occurrence of Townsend ground squirrel in coyote scats after squirrels had supposedly entered estivation and were no longer available to coyotes (Tables 14 and 15). There are two possible explanations for this: (1) ground squirrels continue to come up occasionally even after entering estivation, and do this often enough to make themselves vulnerable to predation by coyotes, or (2) coyotes are able to detect and dig up estivating ground squirrels. It is unknown which of these two explanations is the correct one.

A total of 62 coyote stomachs were analyzed and results (frequency of occurrence only) are presented in Tables 18 and 19. Domestic cattle and black-tailed jackrabbit were the most common items in stomachs.

Table 17. The percent of identified mammalian items which the prey species shown below make up of the total percentage of identified mammalian items in coyote scats collected on the Snake River Birds of Prey Study Area during the spring, summer, and fall of 1977. NS stands for scats collected north of the Snake River; SS stands for scats collected south of the river. (Tr: Trace < 1.0%).

| Species | Spring |  | Summer |  | Fall |  |
|---|---|---|---|---|---|---|
|  | SS | NS | SS | NS | SS | NS |
| Black-tailed jackrabbit | 11.7 | 22.2 | 21.6 | 27.8 | 14.3 | 25.4 |
| Townsend ground squirrel | 6.3 | 26.1 | 13.6 | 15.1 | 11.1 | 12.7 |
| Kangaroo rat | 16.2 | 7.7 | 25.0 | 12.0 | 22.2 | 12.0 |
| Pocket gopher | 11.7 | Tr | 9.1 | Tr | 4.8 | Tr |
| Mountain vole | 32.4 | 8.2 | 8.0 | 6.1 | 3.2 | 9.8 |

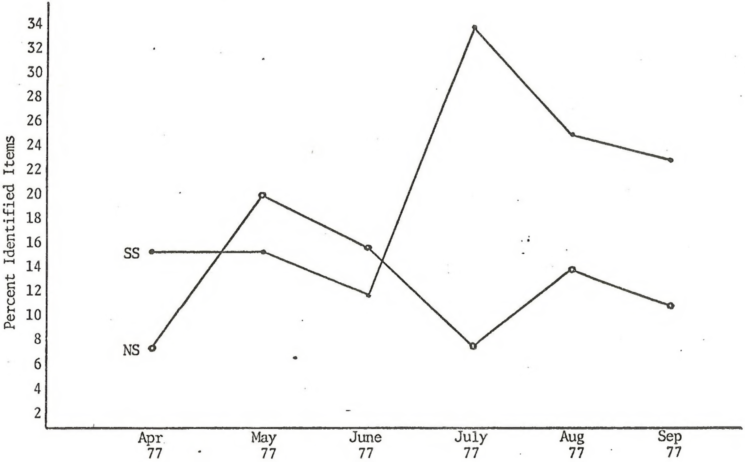

Fig. 6. Monthly variation in the percentage of kangaroo rat individuals found in coyote scats collected on the Snake River Birds of Prey Study Area. NS indicates scats collected north of the Snake River; SS indicates scats collected south of the river.

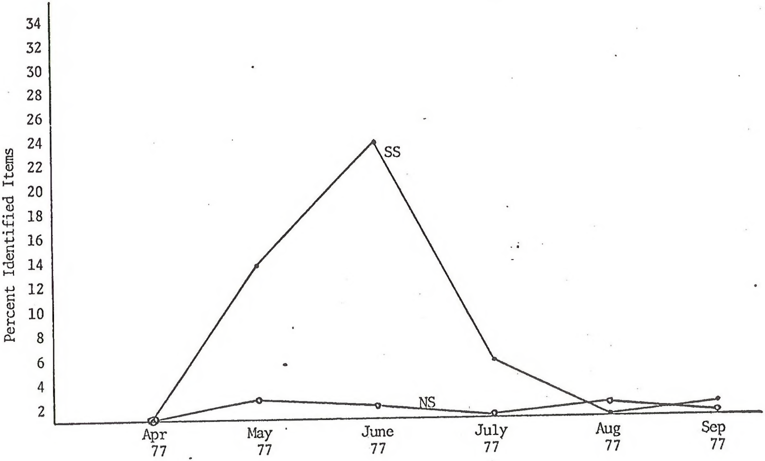

Fig. 7. Montly variation in the percentage of pocket gopher individuals found in coyote scats collected on the Snake River Birds of Prey Study Area. NS indicates scats collected north of the Snake River; SS indicates scats collected south of the river.

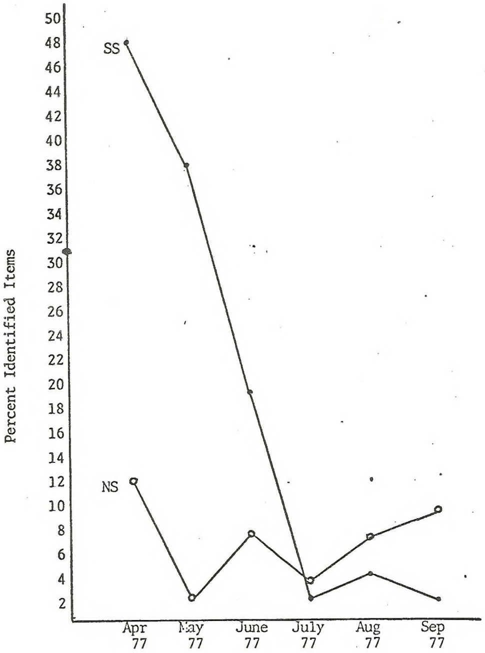

Fig. 8. Monthly variation in the percentage of mountain vole individuals found in coyote scats collected on the Snake River Birds of Prey Study Area. NS indicates scats collected north of the Snake River; SS indicates scats collected south of the river.

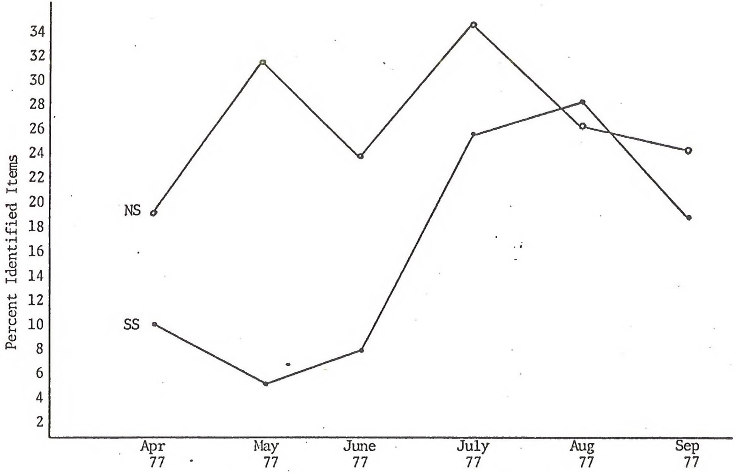

Fig. 9. Monthly variation in the percentage of black-tailed jackrabbit individuals found in coyote scats collected on the Snake River Birds of Prey Study Area. NS indicates scats collected north of the Snake River; SS indicates scats collected south of the river.

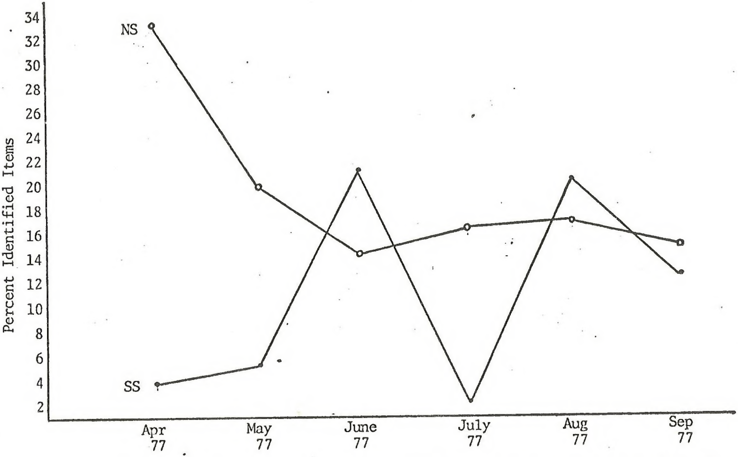

Fig. 10. Monthly variation in the percentage of Townsend ground squirrel individuals found in coyote scats collected on the Snake River Birds of Prey Study Area. NS indicates scats collected north of the Snake River; SS indicates scats collected south of the river.

Table 18. Frequency of occurrence of remains in 34 coyote stomachs collected between January 1975 and July 1977 on the Snake River Birds of Prey Study Area.

| Species | Occurrence |
|---|---|
| MAMMAL | |
| Domestic cow | 17 |
| Black-tailed jackrabbit | 7 |
| Townsend ground squirrel | 2 |
| Ord's kangaroo rat | 2 |
| Domestic sheep | 2 |
| Harvest mouse | 1 |
| House mouse | 1 |
| Mountain vole | 1 |
| Deer mouse | 1 |
| Great Basin pocket mouse | 1 |
| Unidentified lagomorph | 2 |
| Unidentified rodent | 4 |
| Unidentified ungulate | 1 |
| AVIAN | |
| Domestic chicken | 1 |
| Pheasant | 1 |
| Unidentified bird | 8 |
| FISH | |
| Unidentified fish | 1 |
| REPTILE | |
| Unidentified lizard | 1 |
| Gopher snake | 1 |
| INVERTEBRATE | |
| Beetles | 2 |
| Grasshopper | 4 |
| Scorpion | 1 |
| PLANT | |
| Corn | 1 |
| Russian olive seeds | 1 |
| Unidentified vegetation | 13 |
| INORGANIC | 1 |

Table 19. Frequency of occurrence of remains in 28 coyote stomachs collected in September 1977 on the Snake River Birds of Prey Study Area.

| Species | Occurrence |
|---|---|
| MAMMAL | |
| Domestic cow | 6 |
| Black-tailed jackrabbit | 5 |
| Ord's kangaroo rat | 4 |
| Desert woodrat | 2 |
| Pocket gopher | 1 |
| Cottontail rabbit | 1 |
| Domestic sheep | 1 |
| Unidentified lagomorph | 3 |
| Unidentified rodent | 5 |
| AVIAN | |
| Hungarian partridge | 1 |
| Unidentified bird | 3 |
| REPTILE | |
| Unidentified lizard | 1 |
| INVERTEBRATE | |
| Jerusalem cricket | 2 |
| Grasshopper | 5 |
| Caterpillars | 1 |
| PLANT | |
| Corn | 11 |
| Russian olive seeds | 5 |
| Rose hips | 1 |
| Unidentified vegetation | 2 |
| INORGANIC | 2 |

## Coyote Population Parameters

### Age Structure and Survival Rates

Out of 241 coyote teeth that were aged, 151 were chosen for use in the estimation of survival rates. Animals collected during the "winter" months (October to March) were chosen because of larger sample sizes. The age structures used in determining survival rates are presented in Table 20 and the estimated survival rates are presented in Table 21. In many cases the juvenile age class had to be discarded because it was not properly represented in the age structure according to the results of a statistical test found in Robson and Chapman (1961). Adult survival was generally around 70 percent with a total survival (adults plus juveniles) of approximately 60 percent in those winter 1976-1977 samples where it could be estimated.

### Natality

The results of the analysis of 33 coyote reproductive tracts collected between January 1975 and April 1977 are presented in Table 22. The results from the analysis of 27 reproductive tracts collected in September 1977 are presented in Table 23. The data in these two tables can be separated into three groups. Those animals collected between 26 February 1975 and 25 January 1976 represent animals from the spring 1975 breeding population. Coyotes 28, 30, and 43 were not collected on the BPSA and are not included in pregnancy rate and litter size calculations. Those animals collected between 30 June 1976 and 1 January 1977 represent animals from the spring 1976 breeding population. The animals collected between 2 February 1977 and 21 March 1977 (Table 22) and all animals in Table 23 are a sample of the spring 1977 breeding population.

Table 20. Age structures of coyotes collected on the Snake River Birds of Prey Study Area.

| Age | Sep. 1977 | Dec. 1976-Feb. 1977 | Dec. 1976-Mar. 1977 | Nov. 1976-Feb. 1977 | Nov. 1976-Mar. 1977 | Oct. 1976-Mar. 1977 | Winter 1975-1976 |
|---|---|---|---|---|---|---|---|
| 0 | 27 | 11 | 15 | 17 | 21 | 25 | 30 |
| 1 | 7 | 5 | 5 | 6 | 6 | 10 | 3 |
| 2 | 7 | 1 | 3 | 2 | 4 | 5 | 2 |
| 3 | 4 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |
| 5 | 5 | 2 | 2 | 2 | 2 | 3 | 0 |
| 6 | 3 | 1 | 1 | 2 | 2 | 2 | 1 |
| 7 | 4 | 0 | 0 | 1 | 1 | 1 | 0 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 61 | 22 | 28 | 32 | 38 | 50 | 40 |

Table 21. Survival rates of coyotes on the Snake River Birds of Prey Natural Area as estimated by the Chapman-Robson method. Numbers in parentheses represent sample sizes. Total survival represents a survival rate estimated with the juvenile age class included in the age structure. See text for an explanation of why a total survival rate could not be estimated for all age structures.

| Period | Adult surv. rate | 95% confidence interval adult survival rate | Total surv. rate | 95% confidence level total survival rate |
|---|---|---|---|---|
| 9/77 | .756 (34) | .673 < .756 < .834 | ---- | ---- |
| 12/76-2/77 | .750 (11) | .611 < .750 < .889 | .625 (22) | .494 < .625 < .756 |
| 12/76-3/77 | .684 (13) | .532 < .684 < .837 | .591 (28) | .354 < .591 < .828 |
| 11/76-2/77 | .720 (15) | .592 < .720 < .848 | ---- | ---- |
| 11/76-3/77 | .704 (17) | .578 < .703 < .829 | ---- | ---- |
| 10/76-3/77 | .667 (25) | .554 < .667 < .779 | .598 (50) | .509 < .591 < .828 |
| Winter 1975-1976 | .710 (10) | .544 < .710 < .876 | ---- | ---- |

Table 22. Results of analysis of 33 coyote reproductive tracts collected between January 1975 and April 1977. (CL--corpora lutea; CA--corpora albicantia; PS--placental scars).

| Coyote number | Processing date | CL | CA | PS | Comments |
|---|---|---|---|---|---|
| 28 | 01/27/75 | - | 0 | 0 | |
| 30 | 01/27/75 | - | 0 | 0 | |
| 43 | 02/07/75 | - | - | - | Evidence of follicular activity |
| 91 | 02/26/75 | 5 | - | - | Implantation sites not visible |
| 107 | 03/07/75 | 6 | - | 0 | Implantation sites not visible |
| 273 | 09/06/75 | - | 0 | 0 | |
| 294 | 12/01/75 | - | 0 | 0 | |
| 295 | 12/01/75 | - | 7 | 7 | |
| 296 | 12/04/75 | - | - | 0 | Evidence of follicular activity |
| 304 | 01/16/76 | 5 | - | 6 | PS faint. One ovary missing |
| 305 | 01/25/76 | - | 0 | 0 | |
| 306 | 01/25/76 | - | 0 | 0 | |
| 524 | 06/30/76 | - | 0 | 0 | |
| 730 | 08/03/76 | - | - | - | Decomposed and unreadable |
| 791 | 10/05/76 | - | 3 | 3 | |
| 792 | 10/05/76 | - | 0 | 0 | |
| 814 | 10/28/76 | - | 10 | 7 | |
| 828 | 11/11/76 | - | 14 | 9 | |
| 846 | 11/25/76 | - | 0 | 0 | |
| 848 | 11/25/76 | - | 0 | 0 | |
| 853 | 11/25/76 | - | 0 | 0 | |
| 869 | 12/11/76 | - | 2 | 0 | |
| 878 | 12/25/76 | - | 4 | 0 | One ovary unreadable |
| 883 | 01/01/77 | - | 11 | 5 | PS faint, at least 5 |
| 901 | 02/04/77 | - | - | - | Evidence of follicular activity |
| 918 | 02/27/77 | 5 | - | - | Only one ovary ovulated |
| 920 | 02/28/77 | 2 | - | - | One ovary missing |
| 921 | 02/28/77 | - | - | - | Decomposed and unreadable |
| 930 | 03/12/77 | 0 | - | - | |
| 942 | 03/21/77 | 0 | - | - | |
| 943 | 03/21/77 | 0 | - | - | |
| 944 | 03/21/77 | 6 | - | - | Implantation sites not visible |
| 945 | 03/21/77 | 7 | - | 7 | Uterine tissue present in cervix and vagina. Animal either aborted in trap or parturition had occurred. |

Table 23. Results of analysis of 27 coyote reproductive tracts collected during September 1977. (CA--corpora albicantia; PS--placental scars).

| Coyote number | CA | PS | Comments |
|---|---|---|---|
| 2 | 2 | 0 | |
| 4 | 0 | 0 | |
| 6 | 8 | 6 | |
| 7 | 0 | 0 | |
| 9 | 11 | 8 | |
| 14 | 12 | 9 | |
| 17 | 13 | 10 | |
| 18 | 8 | 3 | Minimum PS count. One extensive area of discoloration in uterus probably site of overlapping PS. |
| 19 | 4 | 7 | Not that unusual. CA begin to fade during course of year. Ovaries were triple checked to verify CA number. |
| 24 | 0 | 0 | |
| 25 | 10 | 3 | Very faint PS not counted. |
| 26 | 0 | 0 | |
| 27 | 0 | 0 | |
| 35 | 0 | 0 | |
| 36 | 0 | 0 | |
| 37 | 5 | 7 | |
| 42 | 14 | 5 | |
| 43 | 3 | 8 | One ovary missing. |
| 44 | 0 | 0 | |
| 45 | 0 | 0 | |
| 47 | 0 | 0 | |
| 51 | 0 | 0 | |
| 56 | 8 | 7 | |
| 57 | 0 | 0 | |
| 58 | 0 | 0 | |
| 59 | 4 | 0 | |
| 60 | 0 | 0 | |

Only two animals from the spring 1975 breeding population sample had placental scars. The average number of scars per female was 6.5. Five out of nine animals in this group showed some evidence of reproductive activity. Four coyotes in the spring 1976 breeding population sample had placental scars with an average of 6.0 scars per female. Six of 11 animals showed evidence of reproductive activity. The collection of coyotes representing the spring 1977 breeding population had 12 animals with visible placental scars. The average number per female was 6.67. If coyote number 18 (see Table 23) is excluded the average number is 7.0. Eighteen of 35 (51.4 percent) in this collection showed evidence of reproductive activity.

Sample sizes are unfortunately so small for the spring 1975 and spring 1976 populations that calculation of pregnancy rates and total reproductive ratesis unwarranted. However, there are 28 animals in the spring 1977 collection for whom it could be determined whether or not they were pregnant. Twelve of these 28 (42.9 percent) were pregnant, and multiplying the average litter size of 6.67 by this pregnancy rate estimate yields an estimated total reproductive rate of 286 young/100 females.

## Relative Abundance

The various indices of abundance that were calculated offer no clear-cut pattern of variations in abundance. The aerial golden eagle survey results (Fig. 11) indicate that coyote numbers were generally higher in the early 1970's and have been dropping since 1974. The scent post survey results (Fig. 12) and the number of coyotes seen/observer day (Table 24) do not offer substantiation for this, however.

The average number of scats collected per kilometer of scat line traveled is plotted for both NS and SS lines in Fig. 13. This figure seems

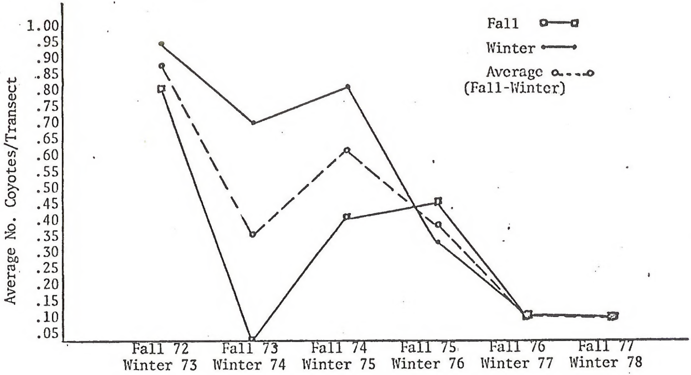

Fig. 11. Variation in the average number of coyotes seen per transect during the semi-annual golden eagle survey.

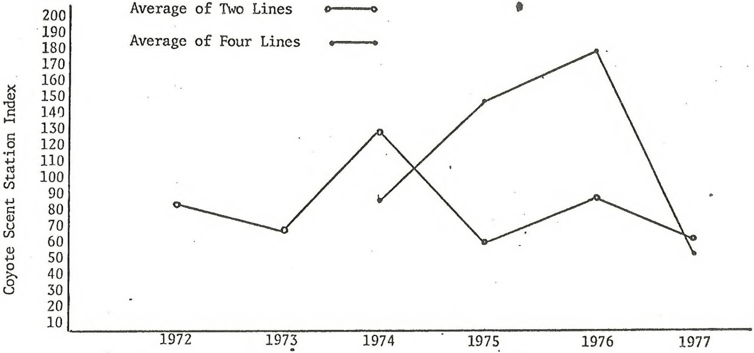

Fig. 12. Fluctuations in the coyote scent station index. See text for description of index.

Table 24. Number of coyotes per observer-day as determined from analysis of field notes covering the period 1 April to 1 July for 1971, 1975, 1976, and 1977.

| Year | Coyotes/observer-day |
|---|---|
| 1971 | 0.155 |
| 1975 | 0.090 |
| 1976 | 0.166 |
| 1977 | 0.153 |

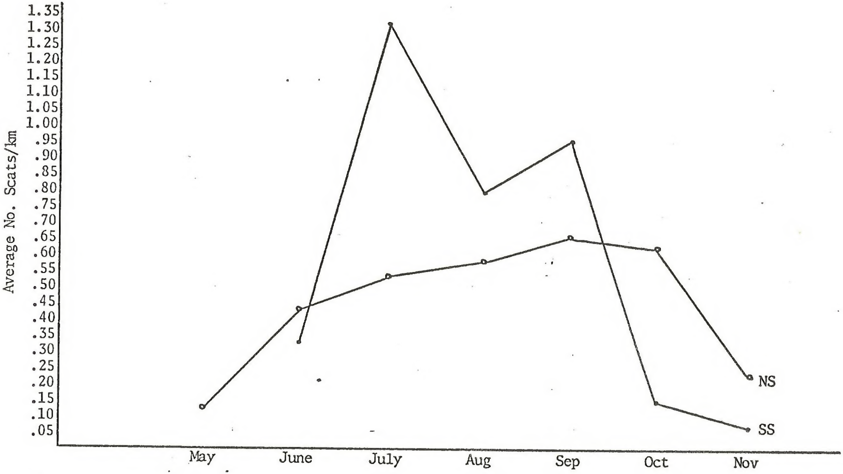

Fig. 13. Variation in the average number of scats collected per km of standard scat lines. NS indicates scats collected on lines north of the Snake River; SS indicates scats collected on lines south of the river.

to indicate that coyotes become more active from spring into summer, probably due to pup groups wandering around. S. Cherry observed much evidence of this increase in activity by possible pup groups at carcasses of cows and in dust and mud on the roads. It was not unusual to find literally hundreds of tracks on some stretches of roads during this period. Activity seemed to drop off in the fall, probably due to increased dispersal. It was our general impression that the coyote population was denser south of the river, and Fig. 13 seems to support this speculation.

## Sex Ratio

Sample sizes of sexed individuals for given seasons (e.g., winter 1975) were generally too small to make meaningful sex ratio comparisons. However, the sex ratio of the 61 animals (27 females, 34 males) collected by aerial gunning in September 1977 was not significantly different from 50:50 ($X^2 = 0.84$; $P < 0.05$). The sex ratio of the pooled sample of all sexed coyotes (69 females, 74 males) was also not significantly different from 50:50 ($X^2 = 0.175$; $P < 0.05$).

## Coyote Energetics

Using the procedure outlined in the methods section, and assuming an average coyote weight of 11 kg, the BMR of an average adult coyote was estimated to be 423 kcal/day. Multiplying by 2.5 yields an average daily maintenance requirement of 1058 kcal/day. Assuming a digestive efficiency of 90 percent, adult coyotes would need approximately 1176 kcal/day for maintenance purposes. Bitches in the latter third of pregnancy and those who are lactating would need an estimated 2940 kcal/day.

The final estimates of pup daily energy intake are shown in Table 25. The values do not show a continued increase due to changes in rate of weight gain. For example, between day 40 and day 50 the pups gained an average of 94 grams/day whereas between day 50 and day 60 they gained an average of only 41 grams/day.

# DISCUSSION

## Coyote Population Parameters

### Survival Rates

The survival rates calculated for BPSA coyotes are the highest reported so far (Table 21). Comparing these rates with those estimated in other studies must be an exercise in caution, however. Survival rates have been determined primarily by using life tables (e.g., Nellis and Keith 1976, Mathwig 1973) or indices of trends in abundance (Knudsen 1976). Age structures were determined by tooth sectioning (Mathwig 1973, Knudsen 1973) and by such subjective indicators as tooth wear (Glier 1968, Nellis and Keith 1976). There is also the problem of collecting a truly random sample of the population. Carcasses have been collected in a variety of ways, each method fraught with its own unique set of sampling biases. The net result is a group of estimates that may not be comparable at all. This needs to be kept in mind during the subsequent discussion.

The general impression one receives from looking at the literature is that coyote populations are subject to low survival rates. Average annual survival has generally fallen between 25 and 50 percent (Nellis and Keith 1976, Mathwig 1973, Gier 1968). Knudsen (1976) estimated the annual survival of Curlew Valley coyotes to be 18 percent one year and 58 percent the other

Table 25. Estimates of energy consumption of coyote pups from weaning at roughly 40 days of age to 230 days of age. See text for details of how intake was estimated.

| Age (days) | Energy consumption (kcal/day) |
|---|---|
| 40- 50 | 687 |
| 50- 60 | 572 |
| 60- 70 | 789 |
| 70- 80 | 867 |
| 80- 90 | 791 |
| 90-110 | 977 |
| 110-130 | 912 |
| 130-150 | 852 |
| 150-170 | 1041 |
| 170-190 | 1098 |
| 190-210 | 1139 |
| 210-230 | 1142 |

year of his study. Knowlton (1972) suggested that adult survival rates might be less than 60 percent even in unexploited populations. The high survival rate of BPSA coyotes is thus somewhat of a mystery. It would be unwise to place too much confidence in the BPSA estimates, however. Sample sizes are very small (Tables 20 and 21) and there were problems with improper representation of the juvenile age class in the age structures. Most of the previous literature estimates fall within the confidence limits of the estimates of this study. More research is needed to determine if BPSA coyotes really do have the high survival rates indicated by analysis of the meager data at hand.

## Natality

Sample sizes were too small to allow any meaningful analysis of natality in 1975 and 1976 on the BPSA. Only the 1977 population will be considered here. The pregnancy rate of BPSA coyotes is comparable to other studies (Table 26), as is average litter size (Table 27).

The estimated average litter size of BPSA coyotes in the spring of 1977 was based on placental scar counts. Other estimates in Table 27 are based on other indicators of number born. For example, Nellis and Keith (1976) estimated litter size based on the average number of young found at each den. This value will typically be smaller than placental scar counts due to postnatal mortality (Knowlton 1972). Hamlett (1938) reported that the average litter size in 1330 female coyotes collected in 13 western stated was 6.2.

## Age Ratios

It is generally assumed that most collection procedures are biased toward younger, less experienced animals. Pups generally made up around

Table 26. Comparison of pregnancy rate estimates for coyote populations from various areas.

| Study | Area | Pregnancy rate (%) |
|---|---|---|
| This study | BPSA[a] | 43 |
| Knudsen (1976) | Curlew Valley[b] | 77 |
| Gier (1968) | Kansas | 48-50 |
| Linhart et al. (1968) | N. Mexico | 46 |
| Linhart et al. (1968) | Idaho | 58 |
| Linhart et al. (1968) | Arizona | 18 |
| Knowlton (1972) | Texas | 54 |
| Nellis and Keith (1976) | Alberta | 50 |

[a] BPSA - Snake River Birds of Prey Study Area.

[b] Curlew Valley is located on the Utah-Idaho border approximately 90 km north of Ogden, Utah.

Table 27. Comparison of coyote litter sizes from various areas.

| Study | Area | Litter size |
|---|---|---|
| This study | BPSA[a] | 6.7 |
| Knudsen (1976) | Curlew Valley[b] | 6.2 |
| Gier (1968) | Kansas | 5.6 |
| Knowlton (1972) | Texas | 5.4 |
| Nellis and Keith (1976) | Alberta | 5.3 |

[a] BPSA - Snake River Birds of Prey Study Area.

[b] Curlew Valley is located on the Utah-Idaho border approximately 90 km north of Ogden, Utah.

50 percent of the age structures in this study (Table 20). This appears to be generally true in most other populations studied (Knudsen 1976, Rogers 1965, Gier 1968, Knowlton 1972). Age ratios with a higher proportion of pups (around 70 percent) have been reported by Mathwig (1973) and Clark (1971). Nellis and Keith (1976) found that 72 percent of the dead coyotes they collected were pups while 55 percent of those collected alive were pups.

## Relative Abundance

The indices of abundance (Figs. 11, 12; Table 24) reveal no clear-cut pattern of fluctuations in coyote abundance on the BPSA. The subjective impression of those people who have worked on the BPSA since the early 1970's is that coyote populations have suffered a general decline (M. Kochert, personal communication). This impression is corroborated by the golden eagle aerial survey (Fig. 11), but not by the scent post survey results (Fig. 12) and coyotes seen per observer-day index (Table 24). These latter two indices are probably not as reliable as the eagle survey, however. Using scent post results to draw inferences about changes in coyote numbers on a local basis is not generally warranted (R. Roughton, U.S. Fish and Wildlife Service, Utah State University-UMC 52, Logan, Utah 84322; personal communication). The coyotes seen per observer-day index was calculated by determining the number of coyotes recorded in field notes of other researchers. These researchers have changed from year to year and have varied in their diligence in recording coyote sightings (M. Kochert, personal communication).

Jackrabbits throughout the northern Great Basin Desert follow a seven-year cycle (Wagner and Stoddart 1972), and coyote abundance typically seems to follow jackrabbit abundance (Clark 1972, Wagner and Stoddart 1972). Jackrabbit abundance in Curlew Valley on the Utah-Idaho border has declined since

1971 with the exception of a slight recovery in 1977 (Stoddart 1977). The coyote population has apparently followed the jackrabbits down during that period (Clark 1972, Knudsen 1976, Stoddart 1977). If jackrabbits on the BPSA have cycled in phase with Curlew Valley coyotes then BPSA coyotes have probably responded much as Curlew Valley coyotes did.

Given the probable greater reliability of the golden eagle survey results, the subjective feelings of those familiar with the area, and the reasonable assumption that BPSA coyotes and jackrabbits and Curlew Valley coyotes and jackrabbits are somewhat comparable, it seems reasonable to speculate that there has been a general decrease in coyote numbers on the BPSA since the early 1970's.

## Energy Flow through the BPSA Coyote Population

The determination of energy flow through the BPSA coyote population requires an estimate of absolute density. No attempt was made to ascertain absolute densities in this study. The gathering of such data requires an expenditure of time and money that was not available. Such estimates may be questionable statistical utility anyway, especially when the species in question is as highly mobile and wary as the coyote. For example, Knudsen (1976: p. 113) estimated a 1974 pup density in Curlew Valley of 133, but the 95 percent confidence limits on that estimate ranged from 33 to 9004. This is a somewhat extreme case, but serves to illustrate the point that a reasonable guess may be as good as spending hundreds or thousands of dollars and manhours to arrive at a statistical estimate, especially in a study of this scope.

Knudsen (1976) reviewed the density estimates reported in the literature and found that pre-whelping density estimates ranged from an average of .08 coyotes/km$^2$ to 0.3 coyotes/km$^2$. Given the 1933 km$^2$ area of the BPSA, this implies a probable population density range of from 155 to 580. The low estimate is almost certainly too low. A total of 61 coyotes was collected by aerial gunning in September 1977 alone and over 200 carcasses were collected during the entire study. It is difficult to imagine this coyote population turning over that fast, especially given the number of relatively old animals in the carcass collections (Table 20). The pre-whelping density of coyotes on the BPSA is probably between 300 and 500. It must be emphasized that this is a *guess*, but a reasonable one.

The timing of mortality is an important factor to consider when estimating energy flow at different seasons. Knudsen (1976) and R. Davison (unpublished data) have evidence based on transmitter recoveries that adults and yearlings suffer only minimal mortality during the spring and summer. It will be assumed that, for all practical purposes, adult and yearling mortality on the BPSA is zero during these two seasons and that it all occurs during the fall and winter. Using the equation $M = 1 - (1 - m)^n$, where M is the annual mortality rate of 30 percent, m is the seasonal mortality rate, and n is the number of seasons considered, it was determined that the fall and winter seasonal mortality rates were 16 percent.

R. Davison (unpublished data) has fall-winter recovery rates of transmittered juveniles of approximately 70 percent. One need only assume that transmittered pups suffer no differential mortality relative to non-transmittered pups and that all lost transmitters were mortalities for mortality rates and recovery rates to be equal. There is no evidence that differential mortality rates occur, and even if the second assumption was totally incorrect, that is, even if all lost transmitters belonged to animals who survived to adulthood, the mortality rate would still be approximately

60 percent. Thus, it will be assumed that overwinter pup mortality on the BPSA approximates 70 percent. Knudsen (1976) estimated birth to fall pup mortality rates of from 40 to 75 percent. These estimates were based on analysis of age ratios known to be biased, however. Knudsen later revised these estimates downward. For the purposes of this report, a spring-summer pup mortality rate of 33 percent will be assumed. Using the formula described above, fall and winter seasonal pup mortality rates of 45 percent and spring-summer pup mortality rates of 18 percent were calculated.

It is now possible to estimate how many coyotes will be present on the BPSA during each season of the year and, using this information, estimate seasonal energy flow. This information will then be coupled with the food habits information to estimate predation intensity of coyotes on the black-tailed jackrabbit and Townsend ground squirrel.

Estimated seasonal densities and energy intakes of a hypothetical BPSA coyote population are shown in Table 28. These values were calculated in the following manner. It was assumed that the pre-whelping spring density of adults was 400 coyotes (200 females, 200 males). Assuming no mortality during the spring and summer and a fall mortality rate of 16 percent this means that 400 coyotes start the fall season and 336 end it for an average of 368 coyotes alive during the fall. Out of the 336 coyotes who enter the winter, 282 survive for an average of 309 alive during the winter. Assuming a reproductive rate of 286 young/100 females, it was determined that 200 females in the spring would give birth to 572 pups. No pup density is shown for spring in Table 28, however, because the adult females lactate throughout the spring and pup energy requirements are taken care of by incrementing the adult female's energy requirements. However, these 572 pups are still

Table 28. Estimated seasonal energy intake of a hypothetical coyote population on the Snake River Birds of Prey Study Area.

| Season | Avg. adult numbers | Avg. pup numbers | Estimated adult energy intake | Estimated pup energy intake | Total energy intake |
|---|---|---|---|---|---|
| Spring | 400 | --- | 51,406 Mcal | --- | 51,406 Mcal |
| Summer | 400 | 427 | 42,300 Mcal | 30,706 Mcal | 73,006 Mcal |
| Fall | 368 | 298 | 38,916 Mcal | 28,273 Mcal | 67,189 Mcal |
| Winter | 309 | 163 | 32,677 Mcal | 17,237 Mcal | 49,914 Mcal |

subject to an 18 percent spring mortality so only 469 of them are weaned in early summer and 385 of these survive until fall, giving an average of 427. Similarly, an average fall density of 298 and an average winter density of 163 was calculated. At the end of the first year 116 pups are recruited into the adult population, essentially replacing the 120 adults who did not survive the year.

Energy intake was estimated using the average daily intakes determined earlier. It was assumed that 86 of 200 females were pregnant and required additional energy during the 60 or so days in spring when they were either in the latter third of pregnancy or lactating. For adult males the estimated average daily caloric intake per male was multiplied by the number of males in the population, and this product was multiplied by 90 (days) to estimate the seasonal requirements. The same procedure was followed for adult females with the exception of having to take the elevated reproductive requirements into account for 60 days in the spring. Essentially the same procedure was followed for pups, but the average daily energy intake had to be adjusted for growth.

By far the most important item in the diet of BPSA coyotes is the black-tailed jackrabbit. The jackrabbit comprised between 50 and 95 percent of relative biomass consumed by coyotes in this study. If the unknown lagomorph constituent of the diet, most of which is probably jackrabbit, is included the percentages are even higher. The jackrabbit probably makes up 50 to 75 percent of the *total* biomass consumed by coyotes on the BPSA. Assuming an average weight of 2110 grams and 1.5 kcal/g live weight an average adult jackrabbit would contain approximately 3165 kcal. An average juvenile at a weight of 1500 grams would contain roughly 2259 kcal.

BPSA coyotes were assumed to eat a jackrabbit mix consisting of 67 percent adults and 33 percent juveniles in the spring and summer; that is, the average jackrabbit eaten weighed 0.67 x 2110 g + 0.33 x 1500 g = 1909 g and contained an estimated 2864 kcal. Assuming this, the hypothetical spring coyote population would eat roughly 9000 jackrabbits if rabbits made up 50 percent of the total energy consumed and about 13,500 jackrabbits if they made up 75 percent of the total energy coyotes consumed.

Gross et al. (1974) estimated spring jackrabbit densities in Curlew Valley to vary from 4 to 37 jackrabbits/km$^2$. Wolfe et al. (1977) estimated spring densities on the BPSA to range from roughly 18 to over 80 jackrabbits/km$^2$, but they questioned the validity of their estimates. At any rate, given the 1933 km$^2$ area of the BPSA, spring rabbit densities could theoretically vary from 7,000 to 15,500 rabbits. Gross et al. (1974) give fall estimates of rabbit densities in Curlew Valley ranging from about 12 to 102 rabbits/km$^2$, while Wolfe et al. (1977) estimated jackrabbit density on the BPSA to vary from about 27 to 63 rabbits/km$^2$. This implies theoretical densities of from 22,600 to 197,000 rabbits on the BPSA. If rabbit numbers are low, then coyotes appear to have, based on the above crude analysis, the potential to exert a high predation intensity on them.

Wagner and Stoddart (1972) estimated that coyotes in Curlew Valley accounted for 50 to 100 percent of jackrabbit mortality during the latter 1960's. More recently, C. Stoddart (personal communication) has indicated he believes coyotes in Curlew Valley are eating anywhere from 10 to 75 percent of the jackrabbit population. The actual percentage taken depends on a complex of factors. Stoddart's (1977: p. 31) latest conclusion, based on analysis of the data at hand, is that "with the observed functional and numerical response of the coyote population to jackrabbit density and with jackrabbit behavioral changes the general trend of the observed jackrabbit 'cycle' can be attributed to coyote predation alone."

The actual intensity of coyote predation on jackrabbits in the BPSA is unknown. However, our preliminary results, backed up by the results of over 15 years of research into coyote-jackrabbit interactions in Curlew Valley, lend support to the speculation that coyotes have the potential to exert heavy predation pressure on BPSA jackrabbits. This leads to further speculation concerning coyote-jackrabbit-golden eagle interactions on the BPSA. This is undoubtedly a very complex situation, but given the extent to which boy coyotes and golden eagles depend on jackrabbits, and the possibility that coyotes are a major controlling factor in jackrabbit population dynamics, the potential for competition between these two important predators appears relatively likely. This situation warrants further study.

Townsend ground squirrels were the other major prey item of the coyote that deserves mention here, due to their prevalence in raptor diets (Kochert et al. 1975, 1976). Generally speaking, ground squirrels made up from 3-9 percent of the relative percent biomass consumed, but almost certainly less than 5 percent of the *total* biomass consumed. In the following discussion, it is assumed that ground squirrels make up 5 percent of the total energy consumed by coyotes in the spring and summer. Ground squirrel densities fluctuate a great deal but have been found to range between 9-33 squirrels/ha (900-3300/km$^2$) in 1975 (Johnson and Melquist 1975) and 2-20 squirrels/ha (200-2000/km$^2$) in 1976 (Johnson et al. 1976). A caloric content of 258 kcal was estimated, assuming an average weight of 172 grams. This implies that about 10,000 ground squirrels would be consumed in the spring and about

14,000 in the summer by the hypothetical BPSA coyote population. Given the estimated ground squirrel densities, it is doubtful if coyotes have much of an impact on Townsend ground squirrel population dynamics on the BPSA, and thus doubtful if coyotes are competing with the raptor population for Townsend ground squirrels.

It needs to be very strongly emphasized that the speculations discussed above are based on very few data and are tentative at best. Continued monitoring of coyote food habits and population parameters is absolutely necessary if any reliable picture of the true role of coyotes in the BPSA ecosystem is to ever be drawn.

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# LITERATURE CITED

Chapman, D. G. and D. S. Robson. 1960. The analysis of a catch curve. Biometrics 16(2):354-368.

Clark, F. W. 1971. Some aspects of the ecology of coyotes in northwestern Utah and south central Idaho. Unpubl. MS, Dept. of Wildl. Sci., Utah State Univ., Logan.

________. 1972. Influence of jackrabbit density on coyote population change. J. Wildl. Manage. 36(2):343-356.

Davison, R. P., W. W. Mautz, H. H. Hayes, and J. B. Holter. 1978. The efficiency and energy requirements of captive female fishers. J. Wildl. Manage. *In press*.

Elsley, F. W. H. 1971. Nutrition and lactation in the sow. pp. 393-411, *In* I. R. Falconer (ed). Lactation. The Penn. State Univ. Press, University Park. 467pp.

Fleharty, E. D., M. E. Krause, and D. P. Stinnett. 1973. Body composition, energy content and lipid cycles of four species of rodents. J. Mammal. 54(2):426-438.

Gessaman, J. A. 1973. Methods of estimating the energy cost of free existence. pp. 3-31, *In* J. A. Gessaman (ed). Ecological energetics of homeotherms: a view compatible with ecological modeling. Utah State Univ. Press, Monogr. Ser. Vol. 20, Logan. 155pp.

Gier, H. T. 1968. Coyotes in Kansas. Revised Edition. Kansas State Coll. Agric. Expt. Sta. Bull. 393. 118pp.

Golley, F. B., G. A. Petrides, E. L. Rauber, and J. H. Jenkins. 1965. Food intake and assimilation by bobcats under laboratory conditions. J. Wildl. Manage. 29(3):442-447.

Goodnight, W. 1973. Wildlife and the Swan Falls-Guffey Project. Idaho Wildl. Rev. 26(1):3-6.

Grodzinski, W. and B. A. Wunder. 1977. Ecological energetics of small mammals. pp. 173-204, *In* F. B. Golley, K. Petrusewicz, and L. Ryszkowski (ed). Small mammals: their productivity and population dynamics. Cambridge Univ. Press, Cambridge. 451pp.

Gross, J. E., L. C. Stoddart, and F. H. Wagner. 1974. Demographic analysis of a northern Utah jackrabbit population. Wildl. Monogr. No. 40. 68pp.

Hadjipieris, G. and W. Holmes. 1966. Studies on feed intake and feed utilization by sheep. I. The voluntary feed intake of dry, pregnant, and lactating ewes. J. Agric. Sci. 66(1):217-223.

Hall, E. R. 1946. Mammals of Nevada. Univ. of Calif. Press, Berkeley. 710pp.

Hamlett, G. W. D. 1938. The reproductive cycle of the coyote. U.S. Dept. of Agric., Tech. Bull. 616. 11pp.

Jense, G. K. 1968. Food habits and energy utilization of badgers. MS Thesis, South Dakota State Univ., Brookings. 39pp.

Johnson, D. R. and W. E. Melquist. 1975. Population ecology and habitat requirements of Townsend ground squirrels. pp. 156-176, *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1975. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 193pp.

________, G. W. Smith, and R. M. Olson. 1976. Population ecology and habitat requirements of Townsend ground squirrels. pp. 203-225, *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1976. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 240pp.

Kaczmarski, R. 1966. Bioenergetics of pregnancy and lactation in the bank vole. Acta Theriol. 11:409-417.

Kaufman, D. W., G. A. Kaufman, and J. G. Wiener. 1975. Energy equivalents for sixteen species of xeric rodents. J. Mammal. 56(4):946-949.

Kleiber, M. 1961. The fire of life. John Wiley and Sons, New York. 454pp.

Knowlton, F. F. 1972. Preliminary interpretations of coyote population mechanics with some management implications. 36(2):369-382.

Kochert, M. N. 1975. Preface. *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1975. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 193pp.

________, A. R. Bamman, R. P. Howard, J. H. Doremus, M. Delate, and D. Donahue. 1975. Reproductive performance, food habits, and population dynamics of raptors in the Snake River Birds of Prey Natural Area. pp. 1-50, *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1975. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 193pp.

________, A. R. Bamman, J. H. Doremus, M. Delate, and J. Wyatt. 1976. Reproductive performance, food habits, and population dynamics of raptors in the Snake River Birds of Prey Natural Area. pp. 1-56, *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1976. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 240pp.

Knudsen, J. J. 1976. Demographic analysis of a Utah-Idaho coyote population. MS Thesis, Utah State Univ., Logan. 195pp.

Linhart, S. B. and F. F. Knowlton. 1967. Determining age of coyotes by tooth cementum layers. J. Wildl. Manage. 31(2):362-365.

Linhart, S. B., H. H. Brusmann, and D. S. Balser. 1968. Field evaluation of an antifertility agent, stilbestrol, for inhibiting coyote reproduction. Trans. N. Amer. Wildl. and Nat. Resour. Conf. 33:316-327.

________ and F. F. Knowlton. 1975. Determining the relative abundance of coyotes by scent station lines. Wildl. Soc. Bull. 3(3):119-124.

Mathwig, H. J. 1973. Food and population characteristics of Iowa coyotes. Iowa State J. Res. 47(3):167-189.

Meiners, W. R. 1970. Snake River Birds of Prey Natural Area--a protective withdrawal. Report to the Director, U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 48pp.

Migula, P. 1969. Bioenergetics of pregnancy and lactation in the European common vole. Acta Theriol. 14:167-179.

Millar, J. S. 1975. Tactics of energy partitioning in breeding *Peromyscus*. Can. J. Zool. 53(7):967-976.

Montan, J. R., Jr. 1977. Rodent density and species composition in the Snake River Birds of Prey Natural Area, Idaho. MS Thesis, Utah State Univ., Logan. 44pp.

Nellis, C. H., L. B. Keith, and S. P. Wetmore. 1972. Lynx-prey interactions in central Alberta. J. Wildl. Manage. 36(2):320-329.

________, and L. B. Keith. 1976. Population dynamics of coyotes in central Alberta, 1964-1968. J. Wildl. Manage. 40(3):389-399.

Randolph, P. A., J. C. Randolph, K. Mattingly, and M. M. Foster. 1977. Energy cost of reproduction in the cotton rat, *Sigmodon hispidus*. Ecology 58(1):31-45.

Robson, D. S. and D. G. Chapman. 1961. Catch curves and mortality rates. Trans. Amer. Fish. Soc. 90(2):181-189.

Rogers, A. H., E. C. Meslow, P. D. Doerr, and L. B. Keith. 1972. Response of great horned owl populations to changing prey densities. J. Wildl. Manage. 36(2):282-296.

Schreiber, R. K. 1973. Bioenergetics of rodents in the northern Great Basin Desert. PhD Thesis, Univ. of Idaho, Moscow. 133pp.

________, and D. R. Johnson. 1975. Seasonal changes in body composition and caloric content of Great Basin rodents. Acta Theriol. 20:343-364.

Seber, G. A. F. 1973. The estimation of animal abundance and related parameters. Hafner Press, New York. 506pp.

Sigler, W. F., M. L. Wolfe, W. T. Helm, and J. M. Neuhold. 1972. The potential and assessment of mitigation of Swan Falls and Guffey Dams on the Snake River ecosystem. Rep. to the Idaho Water Resour. Board. Dept. of Wildl. Sci., Utah State Univ., Logan. 87pp.

Stoddart, L. C. 1977. Population dynamics, movement and home range of black-tailed jackrabbits (*Lepus californicus*) in Curlew Valley, northern Utah. Prog. Rep. U.S. Energy Res. and Development Admin. Contract No. E(11-1)-1329. 42pp.

Wagner, F. H. and L. C. Stoddart. 1972. Influence of coyote predation on black-tailed jackrabbit populations in Utah. J. Wildl. Manage. 36(2):329-342.

Weaver, J. L. 1977. Coyote-food base relationships in Jackson Hole, Wyoming. MS Thesis, Utah State Univ., Logan. 88pp.

Wilson, L. O. 1975. Distribution, season of use, and habitat of the mammals, birds, reptiles, amphibians, and fishes of Idaho. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 132pp.

Wolfe, M. W., J. R. Montan, Jr., K. Montan, J. Wassink, M. Wakefield, and B. James. 1976. Density and composition of small mammals and birds in the Snake River Birds of Prey Natural Area, Idaho. pp. 133-162, *In* Snake River Birds of Prey Research Proj. Ann. Rep. 1976. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 240pp.

________, L. O. Oftedahl, P. Olmstead, J. Johansen, and A. Garcia. 1977. Density and species composition of small mammals and birds on the Snake River Birds of Prey Natural Area, Idaho. pp. 54-81, *In* Snake River Birds o- Prey Research Proj. Ann. Rep. 1977. U.S. Dept. of the Inter., Bur. of Land Manage., Boise, ID. 201pp.

# APPENDIX

Table A-1. Frequency of occurrence of remains in five bobcat scats collected on the Snake River Birds of Prey Study Area.

| Species | Frequency of occurrence |
|---|---|
| Black-tailed jackrabbit | 1 |
| Cottontail rabbit | 2 |
| Mountain vole | 1 |
| Harvest mouse | 1 |
| Large unidentified mammal | 1 |
| Domestic chicken | 1 |
| Grass | 2 |
| Miscellaneous vegetation | 1 |

Table A-2. Frequency of occurrence of remains in four bobcat stomachs collected on the Snake River Birds of Prey Study Area.

| Species | Frequency of occurrence |
|---|---|
| Mountain vole | 1 |
| Muskrat | 1 |
| Deer mouse | 1 |
| Pocket gopher | 1 |
| Cottontail rabbit | 1 |
| Vegetation | 2 |

Table A-3. Frequency of occurrence and number of identified mammalian items in 13 coyote scats collected on the Snake River Birds of Prey Study Area, December 1974 to February 1975.

| Groups and species | Frequency of occurrence | No. identified items |
|---|---|---|
| MAMMAL | | |
| Black-tailed jackrabbit | 1 | 1 |
| Cottontail rabbit | 1 | 1 |
| Townsend ground squirrel | 7 | 12 |
| Mountain vole | 1 | 1 |
| Ord's kangaroo rat | 1 | 1 |
| Harvest mouse | 1 | 1 |
| Domestic cow | 6 | 6 |
| Domestic sheep | 1 | 1 |
| Mule deer | 1 | 1 |
| AVIAN | | |
| Starling | 1 | |
| Unknown bird | 1 | |
| INVERTEBRATE | | |
| Beetles | 2 | |
| Grasshopper | 1 | |
| PLANT | | |
| Grass | 3 | |
| Miscellaneous vegetation | 5 | |
| INORGANIC | 9 | |

Table A-4. Frequency of occurrence and number of identified mammalian items in 14 coyote scats collected on the Snake River Birds of Prey Study Area, June 1975 to August 1975.

| Groups and species | Frequency of occurrence | No. identified items |
|---|---|---|
| MAMMAL | | |
| Black-tailed jackrabbit | 3 | 3 |
| Cottontail rabbit | 1 | 1 |
| Townsend ground squirrel | 10 | 10 |
| Striped skunk | 1 | 1 |
| Badger | 1 | 1 |
| Domestic cow | 1 | 1 |
| AVIAN | | |
| Unknown bird | 1 | |
| INVERTEBRATE | | |
| Beetles | 3 | |
| Grasshopper | 2 | |
| Scorpion | 1 | |
| PLANT | | |
| Grass | 2 | |
| Miscellaneous vegetation | 2 | |
| INORGANIC | 9 | |

Table A-5. Frequency of occurrence and number of identified mammalian items in seven coyote scats collected on the Snake River Birds of Prey Study Area, September 1975 to November 1975.

| Groups and species | Frequency of occurrence | No. identified items |
|---|---|---|
| MAMMALS | | |
| Cottontail rabbit | 1 | 1 |
| Townsend ground squirrel | 2 | 2 |
| Unknown cricetid | 1 | 1 |
| Raccoon | 1 | 1 |
| AVIAN | | |
| Unknown bird | 1 | |
| FISH | | |
| Unknown fish | 1 | |
| INVERTEBRATE | | |
| Beetles | 3 | |
| PLANT | | |
| Hackberry seeds | 1 | |
| Miscellaneous vegetation | 2 | |
| INORGANIC | 2 | |

Table A-6. Frequency of occurrence and number of identified mammalian items in five coyote scats collected on the Snake River Birds of Prey Study Area, December 1975 to February 1976.

| Groups and species | Frequency of occurrence | No. identified items |
|---|---|---|
| MAMMAL | | |
| Domestic cow | 1 | 1 |
| PLANT | | |
| Grass | 1 | |
| Miscellaneous vegetation | 5 | |
| INORGANIC | 2 | |

Table A-7. Frequency of occurrence and number of identified mammalian items in 20 coyote scats collected on the Snake River Birds of Prey Study Area, March 1976 to May 1976.

| Groups and speices | Frequency of occurrence | No. identified items |
|---|---|---|
| MAMMALS | | |
| Black-tailed jackrabbit | 7 | 7 |
| Cottontail rabbit | 1 | 1 |
| Unknown lagomorph | 2 | 2 |
| Townsend ground squirrel | 14 | 22 |
| Mountain vole | 2 | 5 |
| Kangaroo rat | 2 | 3 |
| Deer mouse | 1 | 1 |
| Pocket gopher | 4 | 4 |
| Woodrat | 1 | 1 |
| Pocket mouse | 1 | 1 |
| Unknown cricetid | 1 | 1 |
| Striped skunk | 1 | 1 |
| AVIAN | | |
| Unknown bird | 1 | |
| REPTILE | | |
| Western whiptail lizard | 2 | |
| INVERTEBRATE | | |
| Beetles | 1 | |
| Grasshopper | 1 | |
| Scorpion | 1 | |
| PLANT | | |
| Miscellaneous vegetation | 7 | |
| INORGANIC | 8 | |

Table A-8. Common and scientific names of species in Tables 2 through 16, Tables 18 and 19, and Tables A-1 through A-7.

| Common name | Scientific name |
|---|---|
| MAMMAL | |
| Black-tailed jackrabbit | *Lepus californicus* |
| Cottontail rabbit | *Lylvilagus nuttalli* |
| Townsend ground squirrel | *Spermophilus townsendi* |
| Mountain vole | *Microtus montanus* |
| Kangaroo rat (unknown kangaroo rat) | *Dipodomys* sp. |
| Ord's kangaroo rat | *D. ordi* |
| Deer mouse | *Peromyscus maniculatus* |
| Pocket gopher (unknown pocket gopher) | *Thomomys* sp. |
| Townsend pocket gopher | *T. townsendi* |
| Northern pocket gopher | *T. talpoides* |
| Harvest mouse | *Reithrodontomys megalotis* |
| Woodrat (unknown woodrat) | *Neotoma* sp. |
| Desert woodrat | *N. lepida* |
| Bushy-tailed woodrat | *N. cinerea* |
| Grasshopper mouse | *Onychomys leucogaster* |
| House mouse | *Mus musculus* |
| Norway rat | *Rattus rattus* |
| Pocket mouse | *Perognathus parvus* |
| Muskrat | *Ondatra zibethica* |
| Porcupine | *Erethizon dorsatum* |
| Beaver | *Castor canadensis* |
| Marmot | *Marmota flaviventris* |
| White-tailed antelope ground squirrel | *Ammospermophilus leucogaster* |
| Least chipmunk | *Eutamias minimus* |
| Coyote | *Canis latrans* |
| Spotted skunk | *Spilogal- putorius* |
| Striped skunk | *Mephitis mephitis* |
| Raccoon | *Procyon lotor* |
| Long-tailed weasel | *Mustela frenata* |
| Badger | *Taxidea taxus* |
| Shrew | *Sorex* sp. |
| Pronghorn antelope | *Antilocapra americana* |
| Mule deer | *Odocoileus hemionus* |
| Bat | *Myotis* sp. |
| AVIAN | |
| Raven | *Corvus corax* |
| Starling | *Sturnus vulgaris* |
| Magpie | *Pica pica* |
| California quail | *Lophortyx californicus* |
| Chukar | *Alectoris graeca* |
| Hungarian partridge | *Perdix perdix* |
| Mourning dove | *Zenaidura macroura* |

Table A-8. *Continued.*

| Common name | Scientific name |
|---|---|
| AVIAN (*continued*) | |
| Rock dove | *Columba livia* |
| Mallard | *Anas platyrynchos* |
| Pheasant | *Phasianus colchicus* |
| FISH | |
| Sucker | Catostomidae |
| Crappie | *Pomoxis* sp. |
| REPTILE | |
| Leopard lizard | *Crotophytus wislizenii* |
| Collared lizard | *C. collaris* |
| Western whiptail lizard | *Cnemidophorous rigris* |
| Desert horned lizard | *Phrynosoma platyrhinus* |
| Side-blotched lizard | *Uta stansburiana* |
| Gopher snake | *Pituophis melanoleucus* |
| Striped whipsnake | *Masticophis taeniatus* |
| Western rattlesnake | *Crotalus viridis* |
| Racer | *Coluber constrictor* |
| INVERTEBRATE | |
| Beetles | Coleoptera. |
| Grasshopper | Orthoptera |
| Scorpion | Scorpionida |
| Jerusalem cricket | *Stenopelmatus* |
| PLANT | |
| Grass | Gramineae |
| Shadscale | *Atriplex confertifolia* |
| Sagebrush | *Artemisia tridentata* |
| Hackberry | *Celtis* sp. |
| Russian olive | *Elaegnus angustifolia* |
| Chokecherry | *Prunus* sp. |
| Nightshade | *Solanum dulcamera* |
| Rosehips | *Rosa* sp. |
| Goosefoot family | Chenopodiaceae |

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